STONY, CLEAR AND LOVESICK LAKES IN THE COUNTY OF PETERBOROUGH

RECREATIONAL LAKES PROGRAM

Ontario

Ministry of the Environment

The Honourable George A. Kerr, Q.C., Minister

Everett Biggs, Deputy Minister

1970 RECREATIONAL LAKES PROGRAM

STONY, CLEAR AND LOVESICK LAKES

IN THE

COUNTY OF PETERBOROUGH

Prepared Previously

by

Division of Sanitary Engineering

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TABLE OF CONTENTS

SUMMARY AND CONCLUSIONS

During the summer of 1970, three intensive surveys were carried out to study the water quality of Stony, Clear and Lovesick Lakes in the Kawartha Lakes region. The 11-day surveys were timed to assess water conditions prior to, during and following the height of the summer tourist season.

The water movements in the three lakes were studied during the first two surveys using drogues and fluorescent dyes. With the exception of the areas near the most inlets and outlets, no definite directional pattern of currents could be detected; water movements in all three lakes were found to be influenced by the wind.

The results of the bacteriological surveys were treated statistically and were compared with the OWRC guidelines and criteria respecting total body contact recreational use i.e. geometric mean densities of 1000 total coliforms per 100 ml, 100 fecal coliforms per 100 ml and 20 fecal streptococci per 100 ml.

During the pre-tourist season survey, the bacteriological water quality was generally well within the OWRC criteria. The fecal streptococci counts were highly variable at a few locations inall lake sections but were possibly due to natural (animal) inputs.

The mid-summer bacterial levels in the lakes are summarized as follows:

LAKE	PARAMETER	BACTERIAL LEVELS (Geometric Mean/100 ml)
Lovesick	Total Coliform	1095 to 1966
	Fecal Coliform	30 to 144 *
	Fecal Streptococcus	7 to 89
Stony - Western section west of Hells Gate	Total Coliform	600 to 3400
	Fecal Coliform	20 to 132
	Fecal Streptococcus	10 to 210
Stony - Central and Eastern Sections	Total Coliform	300 to 800
	Fecal Coliform	2 to 65 *
	Fecal Streptococcus	1 to 30
Clear	Total Coliform	160 to 1000
	Fecal Colform	5 to 65
	Fecal Streptococcus	2 to 10

* With large fluctuations of daily counts.

During the mid-summer survey, the bacteriological quality of Lovesick Lake and Stony Lake west of Hells Gate exceeded the OWRC criteria. The results showed that fecal contaminants were entering these lake sections. In general, the bacteriological quality of central and eastern Stony Lake met the OWRC criteria. However, the daily counts in these sections, particularly the fecal coliform bacteria, varied greatly, sufficiently so as to warrant caution in the use of the water for total body contact recreational use. On the basis of fecal coliforms which varied from 115 to 173 organisms per 100 ml,

water along the south shore near McCrackens Landing was also impaired. The flow from Jack Creek greatly exceeded the three OWRC criteria while only the total coliform content in Eel's Creek exceeded the OWRC criteria. The waters of Clear Lake generally met the OWRC bacteriological criteria.

During the post-tourist season bacteriological survey, the total coliform levels exceeded the OWRC criteria in Lovesick, western Stony, the west part of central Stony, and Clear Lakes. However, the lakes were recovering from the load imposed on them by increased human activity during the mid-summer.

All surveys revealed the lakes' surface waters to be well oxygenated.

Thermal stratification was observed during mid-summer in Lovesick Lake, eastern Stony Lake and Clear Lake. Although a temperature drop between top and bottom waters was measured in central Stony Lake in mid-summer, no definite thermocline was detected. By the time of the fall survey, stratification had broken or was in the process of breaking down in Lovesick and Clear Lakes. In eastern Stony Lake, the thermocline had not disappeared but had descended.

Serious oxygen depletion was noted during the mid-tourist season survey in Lovesick and

Clear Lakes below the thermocline and in central Stony Lake; anoxic conditions were found in the north end of Clear Lake. During the fall survey when the thermocline had disappeared, oxygen depletion continued, although not as serious. In eastern Stony Lake, the oxygen content was observed to decrease as the summer progressed. The dissolved oxygen content below the thermocline exceeded 65% saturation in the first survey; exceeded 20% in mid-summer, and was less than 5% in fall. The tendency toward anoxic conditions, even when thermal stratification does not exist, indicates the strong oxygen demand of the decomposing bottom sediments in these lakes.

The chemical quality of the lake waters was generally satisfactory. The average hardness during the fall survey varied from 80 ppm in eastern Stony Lake to 92 ppm in western Stony Lake and Clear Lake.

The lower conductivity and lower nutrient levels in the eastern section of Stony Lake suggest that it is the least productive of all lake sections studied. Other chemical constituents were generally less in magnitude in this lake section.

Although the conductivity of Clear Lake reflected the combined influence of upstream waters during

the early summer, the conductivity thereof exceeded that in upstream flows during the mid and late summer.

The daily sampling showed important variations of water quality which would not be noted if sampling were less frequent. Precipitation affected bacteriological quality during the mid-season and post-season surveys, particularly with respect to the total coliform count. The chemical sampling showed other influences, possibly plug flows, besides precipitation.

It should be noted that while staff of the OWRC conducted this water quality survey, staff of the Department of Health's Public Health Engineering Service conducted an investigation of on-shore private sewage disposal systems. It is expected that an improvement in bacterial water quality will occur when the faulty systems are corrected.

INTRODUCTION

As recommended in the report dated March, 1970, on Environmental Management of Recreational Waters in Cottage Areas in Ontario, field surveys were conducted on selected recreational lakes, with priority being given to Stony and Clear Lakes, both located on the Trent Canal system in Peterborough County. Staff of the OWRC conducted water quality surveys, while staff of the Ontario Department of Health made investigations of private sewage disposal systems serving shoreline establishments.

As a result, three intensive water quality surveys were conducted on Stony, Clear and Lovesick Lakes during the following periods in 1970:

Pre-tourist season	June 19 - 29
Mid-tourist season	July 31 - August 10
Post-tourist season	September 11 - 21

Each survey was of 11-day duration in order to include two weekends within the survey.

PREVIOUS SURVEY

Water quality surveys of Stony and Clear Lakes were conducted on August 14 and September 11, 1969. The August 14 bacteriological samples contained significantly higher total coliform counts than those collected on September 11. Five of the 43 samples collected on

August 14 contained total coliform organisms in excess of the then OWRC objective.

The presence of a high total coliform count in the discharge from Lovesick Lake on August 14, 1969, made it imperative that the 1970 water quality survey include Lovesick Lake as well as Stony and Clear Lakes.

DESCRIPTION OF LAKES

(1) Lovesick Lake

In general, Lovesick Lake, the smallest of the three lakes, is a shallow body of water measuring some 2¼ miles long and 3/4 mile at its widest point. Its deepest sounding of 82 feet is situated in a small area just north (downstream) of Lock 30 at Lower Buckhorn Lake. From this point, the bottom rises to an average depth of some 20 feet in the fairly narrow Trent Canal navigation channel. The balance of the lake is less than 10 feet deep.

Lovesick Lake receives almost all of its water from Lower Buckhorn Lake located to the west. Water may discharge from Lower Buckhorn Lake via six small dams, a large main dam which is located beside Lock 30, and Lock 30 itself. According to information supplied by staff of the Trent Canal system, the lake's inflow during the survey periods consisted mainly of the water passing

over the main dam and, to some extent, that passing through the lock.

The lake empties into Stony Lake mainly via the main dam located east of Lock 28 at Burleigh Falls but also via the dam on Parry's Creek and Lock 28 itself, all at Burleigh Falls.

(2) Stony Lake

This elongated body of water measures some 10 miles in length and 1 3/4 miles at its widest point. For the purpose of this report, Stony Lake may be divided into the following three sections:

(a) Western Section which lies between Burleigh Bay (at Burleigh Falls) on the west and Hells Gate and Piper Island on the east. This section is, to a large degree, a wide (1000 to 2000 feet) deep river carrying water from Lovesick Lake to an area of small islands in the vicinity of Hells Gate, at the south end of which Stony and Clear Lake meet. The north shore of the terminal portion contains a wide area of shallow (less than 6 feet) water and swamp.

(b) Central section lying east of the foregoing

section as far as Bosching Narrows. This area receives flows from the other two sections and empties into Clear Lake via a wide island strewn mouth, south of Hells Gate and the Juniper Island region. Significant development is located at Mount Julian on the north shore and at McCrackens Landing on the south-westerly shore. A relatively small flow of some 40 cfs discharges over a dam located at the south end of Gilchrist Bay into Dummer Lake and hence the Indian River.

(c) Eastern or upper section which lies between Bosching Narrows and Hull Bay at its easterly limits. This section has the deepest sounding of 105 feet. Significant development is situated at Crowes Landing on the south shore and Stonyridge on the north-east shore at Hull Bay. Eels and Jacks Creeks are significant watercourses discharging into Stony Lake from the north; Julia Creek discharges into this section from the south. All water flows westerly to and through Bosching Narrows.

(3) Clear Lake

Clear Lake consists of the body of water

extending from the island complex in the region of Hells Gate south-westerly to Young's Point and Lock 27 of the Trent Canal system. It measures nearly five miles in length and from 5/6 to 1¼ miles in width. Apart from a few small watercourses, the lake receives its flow from Stony Lake and empties through the lock and dam complex at Young's Point. The eastern shoreline consists generally of limestone cliffs. Shallow water areas are limited in extent except among the islands at the north-east end of the lake between Davis Island, Munroe Island and the east mainland. Strip cottage development occurs along both shores with the west shore being more densely developed. Noteworthy centres of development on the lake are Kawartha Park on the north-west shore and the South Beach area near Young's Point.

The water depth is some 30 feet at the centre decreasing to some 20 feet quite close to the east and west shores and ½ mile north-east of South Beach. Opposite South Beach, the water depth is some 15 feet.

SAMPLING CONDITIONS

Each survey represented different conditions regard-

ing recreational use of the lake waters. The pre-tourist season in June and post-tourist season in September evidenced little recreational activity. However, during the mid-tourist season survey, recreational use appeared to be at its maximum, particularly since the first weekend of the survey included a holiday on Monday.

Weather

A record of the air temperature, wind direction and approximate wind velocity during the sampling periods was kept by the sampling crew. A summary of this data is found in Table I.

Water Flows

According to the information received, there are no flow gauging stations in the immediate vicinity of the three lakes. The closest gauging station is located some 18 miles downstream at the HEPC Auburn Dam at Peterborough. The flow data from this station follow:

MONTH	AVERAGE DAY FLOW (cfs)
June, 1970	1098
July	1766
August	1124
September	1332
October	1859
November	2214

The daily flows during the survey periods were as follows:

PRE-TOURIST SEASON SURVEY Day	Day Flow (cfs)	MID-TOURIST SEASON SURVEY Day	Day Flow (cfs)	POST-TOURIST SEASON SURVEY Day	Day Flow (cfs)
June 19	832	July 31	3059	Sept. 11	1867
June 20	955	Aug. 1	2702	Sept. 12	1821
June 21	867	Aug. 2	2620	Sept. 13	1677
June 22	818	Aug. 3	2291	Sept. 14	1520
June 23	880	Aug. 4	1948	Sept. 15	1429
June 24	780	Aug. 5	1331	Sept. 16	1086
June 25	866	Aug. 6	1347	Sept. 17	959
June 26	787	Aug. 7	1713	Sept. 18	921
June 27	908	Aug. 8	827	Sept. 19	894
June 28	703	Aug. 9	911	Sept. 20	848
June 29	812	Aug. 10	930	Sept. 21	1005

According to the information received, staff of the Trent Canal Authority effected very little drawdown of the lakes prior to October 15th. Hence, flows were not artifically altered to any great extent during the survey periods and the daily variations recorded mainly reflected changing runoff patterns. The high flows at the beginning of the MID survey were probably due to the heavy rain on July 31. The decreasing flows during the final (POST) survey do not appear to reflect any rainfall; they were probably due to minor lake level adjustments in the system.

FIELD WORK

The field work consisted of the collection of water samples for bacteriological and chemical analyses

in a laboratory as well as field determinations of dissolved oxygen, temperature, and pH by means of electronic instruments. The sampling point locations are shown on the map enclosed with this report. In addition to the collection of these samples, profiles of the dissolved oxygen and temperature were determined mainly in the deep sections and studies of water movements were carried out.

A summary of the number of stations sampled and the number of samplings per station follows:

BACTERIOLOGICAL SAMPLING

SURVEY	NUMBER OF STATIONS Surface	Depth	VISITS PER STATION
PRE	84	6	11 visits to 25 stations 5 to 7 visits to remainder
MID	84	6	11 visits to 32 stations 5 to 7 visits to remainder
POST	72	4	11 visits to 21 stations 3 to 6 visits to remainder

CHEMICAL SAMPLING

SURVEY	Surface	Depth	VISITS PER STATION
PRE	31	4	2 visits to 3 surface stations 1 visit to remainder
MID	17	0	6 visits to 2 stations 1 visit to remainder
POST	8	0	11 visits to 5 stations 10 visits to remainder

The surface bacteriological samples were generally taken in sterile 250 ml autoclavable polycarbonate bottles from a depth of approximately one meter below the water surface. Depth bacteriological samples were taken using sterile 237 ml rubber air syringes employing a modified "piggy-back" sampler. The surface chemical samples were collected generally in two 32-ounce bottles from a depth of approximately one meter. The depth chemical samples were collected by means of brass Kemmerer samplers.

Immediately after collection, the bacteriological samples were stored in ice in order to preserve the water samples until delivered to an OWRC mobile bacteriological laboratory for analysis. The chemical samples were either shipped or delivered to the Ontario Water Resources Commission Laboratory in Toronto for analysis.

LABORATORY ANALYSES OF SAMPLES

All bacteriological samples from the intensive surveys were analyzed for total coliform (TC), fecal coliform (FC) and fecal streptococcus (FS), usually 2 to 6 hours after sampling, at the mobile laboratory. Analyses were performed using the membrane filter technique as specified in "Standard Methods for the Examination of Water and

Wastewater", twelfth edition 1965, APHA, AWWA, WPCF. The only modification was the use of MacConkey MF broth in the FC analysis.

The OWRC laboratory in Toronto analyzed the chemical samples for up to 16 chemical constituents which included nitrogen and phosphorus determinations.

WATER MOVEMENTS

An attempt was made to determine the movements of water at various locations in the lakes during the first and second intensive water quality studies. In this regard drogues and fluorescent dyes were used by introducing the two into the water at various depths and during times of different wind directions.

The methology and results of this phase of the study follow:

(1) Lovesick Lake

Determinations of current movements were carried out at a number of stations located at various points on the lake. Repeated observations indicated that currents in this lake were governed by the direction of the wind, except in the proximities of the inlets from Lower Buckhorn Lake and the outlet to Stony Lake at Burleigh Falls.

The discovery of the existence of fairly thick layers of bottom sediments in a colloidal state

along the navigation channel indicated that flow-through velocities were quite low in this lake, even in the channel.

Such findings were unexpected. The retention time in Lovesick Lake during the survey periods was approximately three days and ranged from about one and one-half days to six days depending on flow. Such retention times are very short and therefore one would have ordinarily expected the substantial net flow to be noticeable in currents or flow velocity, particularly in the channel. However, this was not the case.

(2) Stony Lake

In the area between Horseshoe Bend and the south-west tip of the Horseshoe Island (in the western section of the lake), no definite current patterns could be found, other than that governed by the direction of the wind. Tests were also carried out repeatedly at Stations 7 and 8 (between Hurricane Point and the south mainland) to determine if any noticeable current existed through the shallow and narrow passage leading easterly to Devils Elbow in the Hells Gate region. The dye introduced into the water, on a number of calm days, simply dispersed in all directions.

In order to determine if there was any detectable movement of subsurface water from east to

west in the Bosching Narrows area, drogues and tracer dye were introduced at 10-foot water depths simultaneously at Stations 43, 44 and 45 (east of Bosching Narrows) a number of times during occasions of different wind directions. On each occasion, the drogues moved with the direction of the wind. Tracer dye showed no directional patterns of movements at depths of 10 feet and deeper; it simply dispersed in the water.

Similar tests were also carried out in the central section at Stations 66, 67 and 68 which form a range between McCrackens Landing and Eagle Mount Island. At this location the results were the same; the movement of the subsurface current was found to be influenced by the direction of the wind.

(3) Clear Lake

The water movements in Clear Lake were studied at Station 15 at the north end and Station 33 at the extreme south and (outlet) opposite South Beach.

At Station 15, no definite patterns of current movement could be detected either by use of drogues or tracer dyes. At Station 33 a current at approximately 200 feet per hour in the direction of the lake outlet at Young's Point was observed.

BACTERIOLOGICAL INTERPRETATION

The bacteriological results were evaluated by staff of the Bacteriology Branch, Division of Laboratories, on the basis of the geometric means of the bacterial counts obtained at each station during the survey. In the statistical analysis of the means, a mean for a station was compared with those of all the other stations on the lake. This comparison was accomplished by graphically comparing the geometric means and 95% confidence limits on the means. In this method, if the confidence limits of two means did not overlap, the two means were significantly different from each other. If the confidence limits of two means overlapped with neither mean included in the overlap, usually the means were significantly different. In all other cases of overlap there was no significant difference between the means. Comparison of means between stations in one survey, and comparison of means for each of the same stations for the three surveys, allowed trends to be determined which facilitated statistical interpolation between stations and surveys. Each station's results were important only as a part of the whole picture.

Simultaneously, all means were compared to the water quality criteria for total body contact recreation as set forth by the OWRC in "Guidelines and

Criteria for Water Quality Management in Ontario" (June 1970). These criteria state that recreational waters can be considered impaired when the geometric mean densities exceed any of the following:

1000 total coliform organisms per 100 ml
100 fecal coliform organisms per 100 ml
20 fecal streptococci organisms per 100 ml

All bacterial concentrations stated subsequently are geometric means of the observations of a survey, except where otherwise specified.

BACTERIOLOGICAL RESULTS

The geometric means of the bacterial counts are presented in Table II and on the enclosed map.

Lovesick Lake

During the PRE survey, the bacterial counts were low. All stations had geometric means counts of 24 to 59 TC/100 ml and 3 to 24 FC/100 ml; most stations had counts of 2 to 9 FS/100 ml. Significantly higher FS means occurred at Station 73 (10/100 ml), 77 (9/100 ml) and 82 (21/100 ml). These higher FS means were probably due to a natural (animal) pollution source at or near these stations.

In the MID survey, all the TC and many of the FC and FS means increased significantly. In mid-summer, the TC means (1000 to 2000/100 ml) exceeded the OWRC recreational water criteria and no station was significantly different from any other. The FC counts at all stations varied widely with time. The FC geometric means at Stations 72, 73 and 74 were at or near the 100 FC/100 ml criteria. Station 77 at 143 FC/100 ml was above the OWRC criteria and the remaining stations except Station 75 showed less than 50 FC/100 ml. Station 75, which is influenced by the flow near Station 76, had a geometric mean of 61 FC/100 ml.

The FS counts, although not as variable with time, showed a greater variation with stations during the MID-survey. At Stations 78, 79 and 82, the FS means were above the

20/100 ml level, with mean concentrations of 30/100 ml, 27/100 ml and 89/100 ml respectively. Station 82 was significantly higher than the other stations during the MID survey. This supports earlier findings about Station 82. All the remaining stations had FS means lower than the criteria except the stations near the northern shore which tended to be higher. This pattern of results indicated that the water of Lovesick Lake at the time of the MID survey tended to be impaired.

During the MID survey water along the southern shore (Stations 73, 74 and 75) had high TC, high FC and lower FS means which indicated a human fecal pollution source. Station 77 was particularly high in TC and FC counts; however, the source thereof is not known at this time. By comparison, Stations 79 through 83, on the northern shore, were in better condition with the increase in FS showing a possibly higher incidence of impairment from natural animal sources. The FC were widely variable in this section making it unacceptable for recreational purposes. This pollution may have been caused by heavy rains at the beginning of the survey, but the counts were also high on the second weekend

of the survey when meteorological influences were minimal.

The pattern in the POST survey differed from that presented in either of the previous surveys. At this time, TC were high (means of 600 to 3500/100 ml), generally above the OWRC recreational criteria, and increasingly variable. However, FC means were very low (means between 2 and 10/100 ml). FS means were also generally low (means of 2 to 8/100 ml), with slightly higher means at Stations 78 (11/100 ml) and 82 (13/100 ml). This pattern suggests that the water had previously received contamination but subsequently the fecal contamination input had decreased or had been eliminated. In such a situation, the TC organisms typically continued to multiply, but the more sensitive FC indicator had all but been eliminated.

Although Lovesick Lake was noted to be impaired during the peak population summer season, the POST survey indicated that the water was recovering.

Stony Lake - Western Section

In the PRE survey, the TC levels were low (geometric means of 35 to 80/100 ml) and the variation from station to station was very small. The FC means, at this time, were at levels between 4 and 20 FC/100 ml and tended to decrease from Station 2 -

toward Station 12.

The FS means varied widely, generally from 10 to 90/100 ml. However, the means at Station 2 (69/100 ml), 10 (90/100 ml) and 11 (79/100 ml) were higher, and in some cases significantly higher than those at the other stations.

During the MID survey the stations on this section of the lake had TC levels above the OWRC criteria. A significant decreasing tendency in TC levels, from Station 2 (2600 TC/100 ml), which is at the outlet of Lovesick Lake, through to Station 12 (917 TC/100 ml) was in evidence. Hence, the effect of high counts in Lovesick Lake on the quality of water in Stony Lake was unmistakeable.

The FC means generally maintained a constant level of 70 to 130/100 ml with only Stations 10, 11 and 12 being lower (20 to 40/100 ml). The FS showed a significant decrease in means with distance from Station 2 (210 FS/100 ml) through the mid-section range (30 to 56 FS/100 ml) toward Station 12 (4 FS/100 ml).

During the POST survey, TC means at Station 1 to 6 and 12 were high (1600 to 2500 TC/100 ml), and were above the OWRC recreational use criteria of 1000 TC/100 ml. At Station 7 to 11, the TC levels

were lower (400 to 920/100 ml). However, the FC levels had decreased significantly from the MID survey level to 3 to 20 FC/100 ml. The FS, again, as in the MID survey showed a significant decrease with distance from Station 2 (86 FS/100 ml) through the mid-section range (8 to 13 FS/100 ml) to Station 12 (2 FS/100 ml).

The pattern of observations shown in this section of Stony Lake indicated an increase in fecal pollution in the mid-summer season to the point of impairing the water quality for recreational uses. The lake, however, was recovering towards an acceptable level as the summer population decreased (POST survey). The main sources of fecal pollution were in and around the Burleigh Falls area, with a major contribution from the outflow of Lovesick Lake (Station 2). However, the residential development in the area was also contributing to the problem since the FC levels were maintained for some distance downstream.

<u>Stony Lake - Central and Eastern Sections</u>

Three sampling ranges were set up. Two ranges consisting of Stations 37 to 40 running from Mount Julian to the east end of Eagle Mount Island, and Stations 66 to 68 running from the west end of Eagle Mount

Island to McCrackens Landing, would monitor the central section; Stations 43 to 45 east of Bosching Narrows would monitor the water leaving the eastern section.

During the PRE survey, TC means were generally low varying generally from 15 to 100/100 ml; no difference between the eastern and central (Mount Julian and McCrackens Landing) stations of the lake were apparent. Only the inflows of Eels Creek (Station 49), 75 TC/100 ml, Jack Creek (Station 51), 144 TC/100 ml and Julia Creek (Station 56), 55 TC/100 ml, marred this trend. FC counts were generally uniformly low (1 to 6/100 ml), again with higher means at the inflowing streams - Eels Creek (12/100 ml), Jack Creek (93/100 ml), and Julia Creek (8/100 ml). The FS means presented a completely different pattern. The stations on the north shore, with the exception of Station 36 located west of Mount Julian, were significantly lower than the stations on the south shore. But even in this situation, peaks at inflowing streams could be discerned. The north shore stations had means generally in the range of 1 to 5 FC/100 ml with Station 36 at 24/100 ml and Eels Creek at 19/100 ml. Jack Creek again was significantly high at 95 FS/100 ml. The south shore had means generally from 9 to 30 FS/100 ml. However, Stations 65, 66 and 67 near McCrackens Landing were more similar to the north shore with lower FS means (1 to 2/100 ml).

During the MID survey, the TC means for Stony Lake were uniform between 300 and 800 TC/100 ml with no discernable trends. Eels Creek and Jack Creek were significantly higher at 2,170 and 2,390 TC/100 ml respectively, which is above the OWRC recreational use criteria of 1000 TC/100 ml. FC counts varied widely with time, with most stations showing low counts and counts in the 200 to 500/100 ml range. Trends of means were not visible, with most stations between 2 and 65 FC/100 ml. Jack Creek (176/100 ml), and the region around McCrackens Landing (115 to 173/100 ml) had FC levels greater than the recreational objective of 100 FC per 100 ml, and significantly greater than those at the other stations. Again, as in the PRE survey, the FS levels presented a north-south split with Stations 61 through 67 being as low as those on the north shore. At the north shore stations, FS levels ranged from 1 to 4/100 ml. The south shore which in this case included Stations 56 to 60 and 68 to 70, had a FS level of 8 to 30/100 ml. Jack Creek was significantly high at 388 FS per 100 ml. Eels Creek, at 18 FS/100 ml, was higher than other stations in the region.

During the POST survey, the TC level was

significantly higher in the Mount Julian range (Stations 37 to 40) at 1030 to 2300 TC/100 ml, and in the McCrackens Landing range (Stations 66 to 68) at 840 to 1370 TC/100 ml than the lake in general which showed 100 to 500 TC/100 ml. Jack Creek again was significantly higher than the norm at 820 TC/100 ml and Eels Creek was slightly higher (430/100 ml). FC levels were low (1 to 10 FC/100 ml) with Jack Creek being higher at 16/100 ml.

FS levels were similarly low (1 to 10/100 ml) with the higher levels occurring at the eastern end of the lake. The FS level at Jack Creek (350/100 ml) was significantly higher than that at any other station during the POST survey of Stony, Clear and Lovesick Lakes.

From the above summary of the surveys of the central and eastern sections of Stony Lake, the main influencing factors apparently were the three inflowing streams. At no time during the surveys did the bacterial levels exceed the recreational water quality criteria except in the inflows of Jack and Eels Creeks and during the POST survey at the Mount Julian and McCrackens Landing ranges. In the latter of these exceptions, only the TC objective was exceeded. All

other indicator levels were quite low. The pattern of the results for the rest of the lake would suggest that the lake was being flushed out and the high levels at these ranges were merely the residual impairment.

During the mid-summer season, the average water quality was acceptable. However, because of the fluctuations in FC counts, individual stations may, at particular times and for short periods, exceed the OWRC criteria. The steady state of high FS levels in the region of Stations 56 to 60 (Crowes Landing) may be indicative of a continuous low level of animal contamination of this section of the lake from agricultural enterprises.

The contamination entering the lake with the inflowing streams was apparently of animal origin since, although the FC levels were high, the FS levels were even higher.

Thus with the exception presented by the wide fluctuation in FC during mid-summer, the eastern and central sections of Stony Lake met the OWRC criteria for total body contact recreational use.

Clear Lake

The lake was sampled in the pattern of four

ranges located at intervals down the flow. Stations 14 to 16 (Range I) were located to determine the quality of water leaving Stony Lake. Stations 20 to 22 (Range II) formed a range one-third of the way downstream at Sandy Point. Stations 25 to 28 (Range III) formed the third range at the two-thirds mark. The fourth range (Range IV) stretched across the outflow of the lake from South Beach (Stations 31 to 34).

The TC counts in the PRE survey were low, with geometric means of 50 to 160 TC/100 ml. The TC concentrations tended to increase in the direction of flow with Range I having means of 50 to 70 TC/100 ml and Range IV having means of 110 to 160 TC/100 ml. Both FC and FS levels were 1 to 5 organisms per 100 ml with Stations 13 and 14 being the only exception, showing 10 and 11 FC/100 ml and 15 and 18 FS/100 ml respectively.

During the MID survey, TC, FC and FS levels were all below the recreational use criteria at 150 to 990 TC/100 ml, 11 to 65 FC/100 ml and 1 to 10 FS/100 ml, respectively. Higher bacterial levels tended to appear at the inshore stations and lower levels at the mid-lake stations. Although the counts at

each station generally did not vary widely, it was noted that FC counts at 19 out of 32 stations exceeded 100 FC/100 ml, particularly on August 5 (Wednesday) and 7 (Friday). The causes and significance of these counts are not presently known.

During the POST survey, the TC levels increased from MID survey levels to a range of 842 to 1920 TC per 100 ml. Most were above the OWRC recreational water criteria. However, both FC and FS levels were low at 1 to 100 bacteria per 100 ml.

With the exception of the TC levels in the POST survey, the bacterial geometric mean densities in Clear Lake never exceeded the OWRC criteria for total body contact recreational use. The increased level of TC in the POST survey may represent a build-up of TC as the lakes and streams upstream were flushed out. This is compatible with the observation of bacterial levels in Stony Lake during the same survey.

Depth Stations

During the three intensive surveys, the

following six depth stations were sampled:

Station	Location	Depth
21D	Clear Lake opposite Sandy Point at the centre of the channel	30 feet
38D	Stony Lake south of Mount Julian	30 feet
44D	Stony Lake east of Bosching Narrows	40 feet
60A	Middle of eastern Stony Lake south of Eels Creek	40 feet
60B	Eastern Stony Lake south-west of Eels Creek outflow	40 feet
76D	Middle of Lovesick Lake in channel	25 feet

Except for the total coliforms and fecal streptococci at Station 21D and fecal coliforms at Station 38D during the MID survey, the bacterial levels at all of the depth stations during all three surveys were identical to those found at the corresponding surface stations. In the case of the exceptions the bacterial level was always lower at the depth station. These stations did not reveal any additional information about the general pollution levels in the lakes.

DISSOLVED OXYGEN AND TEMPERATURE CONSIDERATIONS

The dissolved oxygen and temperature field data are summarized in Table II.

Lovesick Lake

During the PRE survey, the surface lake water had a temperature of approximately 21°C and was well oxygenated with values generally between 105 and 110% saturation. The bottom waters at Station 76 had a temperature of only one degree less whereas the oxygen saturation was 65%.

In the MID survey, the surface water temperature had risen to approximately 23.5°C; the oxygen saturation was more variable than in the PRE survey but remained between 100 and 110% saturation.

The surface temperature and oxygen content fell in the POST survey approximately 5.5° to approximately 18°C and to slightly less than 100% saturation respectively. At Station 76, the bottom temperature was the same as that at the surface; the bottom oxygen content was 84% saturation.

The vertical distribution of oxygen and temperature was recorded twice at Station 76 and once in the lake's deepest section some 1500 feet downstream of the dam near Station 78. A graphical representation of the data is found in Figure 1.

At Station 76 in the 25-foot navigation channel,

a marked temperature decrease from 21.2°C to 18.0°C occurred during the MID survey only within the bottom five feet, whereas a minor decrease occurred approximately at mid-depth during the POST survey. This indicates that thermal stratification had occurred with the thermocline (temperature transition zone between upper warm waters known as the epilimnion and colder bottom waters known as the hypolimnion) being situated close to the bottom; however, the nearly uniform temperature evident in the POST survey indicated that the stratification was in the process of breaking down or may have been broken down temporarily on previous occasion(s). A marked depletion of oxygen in the bottom waters was present during both surveys. During the POST survey, the oxygen content also peaked to nearly 130% saturation at a depth of 15 to 20 feet below the surface; this may be due to a concentration of algae in the thermocline. However, the possible influence of oxygen super-saturated water from the upstream dam cannot be ignored.

The nearly uniform temperature observed near Station 78 (see Figure 1) during the POST survey indicates the breakdown and/or the absence of thermal stratification. A peaking in the oxygen content similar to that at Station 76 occurred at this station.

Stony Lake - Western Section

During the PRE survey, the temperature of the surface water ranged from about 19°C at the upstream end to approximately 18.5°C near Hells Gate; this is at least two degrees cooler than that of Lovesick Lake. The oxygen content ranged generally from 100% to 110% saturation.

During the MID survey, the surface water temperature increased to slightly less than 23°C on the average and the oxygen varied from 95% to 105% saturation.

In the POST survey, a decrease occurred in the temperature and oxygen content similar to that experienced in Lovesick Lake. Temperatures were generally from 17.0 to 17.5°C and the oxygen content, from 95% to 100% saturation.

In general, values in western Stony Lake were less than those in Lovesick Lake.

Stony Lake - Eastern Section

The temperature of the water leaving this section (sampled at Stations 43 to 45 east of Busching Narrows) was approximately 18.2°C in the PRE survey, rose to approximately 22.7°C in the MID survey, and dropped to 17.7°C during the POST survey. The dissolved oxygen content during these periods were approximately 105%, 109% and 93% saturation, respectively. This was similar to the fluctuation observed in Lovesick Lake.

In the PRE survey, a difference was noted between the north and south shores. Along the south shore, the temperature and the dissolved oxygen were approximately 19.5°C and 100 to 105% saturation, respectively, whereas these parameters had values of 18.5° and less than 100% saturation respectively, along the north shore. The lower values were probably due to the inflows from Jack and Eels Creeks. However, no significant difference was observed between the two shores during the MID survey, although both the creeks' flows had lower oxygen saturation values and temperatures. During the POST survey, the temperature

along the south side was the same as that leaving this section but varied along the north shore with low values (17.1°C) for the creek inputs and higher values (18.1°C) in Young Bay.

Oxygen and temperature profiles were measured once each survey at Station 60A, located north of Crowes Landing in the area of greatest depth (see Figure 2). On June 23, the temperature dropped 7.5° to a value of 11°C and the oxygen content dropped 45% to a value of 65% saturation within 50 feet. It is noted that during the PRE survey, the depth samples at Station 44 showed the oxygen saturation and temperature to be 46% and 11.2°C respectively; these values generally corroborate the findings at Station 60A at the same depth. On the basis of the above information, it appears that thermal stratification accompanied by some oxygen depletion in the hypolimnion had occurred. The data collected on August 4 during the MID survey definitely shows pronounced thermal stratification with the thermocline being situated between 20 and 30 feet below the surface. The temperature in the hypolimnion varied from 8 to 11°C and the dissolved oxygen, from 20% to 35% saturation. Hence, oxygen depletion was continuing. On September 21, the temperature difference was not as great but the thermocline still existed,

although some 20 feet lower. It should be noted that lowering of the thermocline is a natural occurrence. The oxygen saturation values differed with the surface values more than during the MID survey; values less than 5% indicated near anoxic conditions in the hypolimnion, namely, 50 feet or more below the surface. As found previously, the oxygen content and temperature at Station 44 during the POST survey corroborated the values found at Station 60A at the same depth.

Stony Lake - Central Section

During the PRE survey, the temperature varied from 18.5 to 19.5°C and the oxygen saturation was generally 95 to 105%.

During the MID survey, the temperature rose to 22.5 to 23.0°C, the temperature of the other two sections of Stony Lake. The dissolved oxygen saturation was 105% to 110%, which is the same as found in eastern Stony Lake.

In the POST survey, the temperature and dissolved oxygen fell to 17.5 to 18.5°C and 100% to 110% saturation, respectively.

A profile of the temperature and dissolved oxygen (see Figure 3) was taken once on August 8 (during the MID survey) at Station 40 located north of Eagle Mount Island in the navigation channel. A temperature difference

of 4°C existed in 45 feet of water. No definite thermocline was observed. The small temperature difference and relatively warm bottom waters indicates that mixing of top and bottom waters had occurred. The dissolved oxygen saturation exceeded 95% in the upper 20 feet but dropped to 36% in the next five feet and then to less than 5% at a depth of 45 feet. This serious oxygen depletion in the deep water is attributed to the high oxygen demand of the decomposing bottom sediments. In view of the strong tendency toward oxygen depletion in the hypolimnion, it is reasonable to expect that some areas in the vicinity of Station 40 will become anoxic.

Clear Lake

During the PRE survey, the surface dissolved oxygen varied from 105% to 110% saturation at the north or inlet end to 95% to 100% opposite South Beach. The dissolved oxygen during the MID survey varied from 110% to 115% saturation throughout the lake and was slightly less than 100% during the POST survey. The oxygen content in Clear Lake was the highest of all three lakes during the MID survey.

The surface temperatures were generally uniform throughout the lake. The temperature was 19.0 to 19.5°C during the PRE survey, rose to 22.6 to 23.2°C (slightly warmer than central Stony Lake), and then fell to 17.5 to 18.0°C

during the POST survey.

Dissolved oxygen and temperature profile measurements were taken on August 6 during the MID survey in upper Clear Lake at a point in the navigation channel east of Station 16 and at Station 21 and also in lower Clear Lake at Station 27. The results (see Figure 4) indicate weak thermal stratification with a temperature drop of at least 2°C occurring at a depth of 15 to 20 feet below the surface. The dissolved oxygen exceeded 105% saturation in the epilimnion, decreased to less than 40% saturation in the hypolimnion, and was down to 5% saturation or less at the bottom. Anoxic conditions were found at the bottom in the navigation channel east of Station 16. The oxygen depletion is attributed to the decomposing bottom sediments.

On September 21 during the POST survey, studies conducted at Station 27 (see Figure 4) revealed a temperature difference of about one degree in 40 feet of water. Hence, thermal stratification had disappeared and was probably followed by mixing, thereby leaving the lake generally homothermal. However, oxygen depletion was still evident, although not as serious as during the MID survey and limited only to the bottom. The oxygen saturation exceeded 115% in the top 10 feet, dropped to above 80% saturation in the next 20 feet, and then decreased sharply to 20% saturation in the bottom 10 feet.

CHEMISTRY

The laboratory results pertaining to the chemical samples are summarized in Table III (PRE survey) Table IV (MID survey) and Table V (POST survey).

Lovesick Lake

The values for free ammonia nitrogen were observed to be higher (highest value was .15 ppm) and vary more widely during the PRE survey than during the other two surveys. The free ammonia dropped to approximately .02 ppm during the MID survey and approximately 0.03 ppm during the POST survey. The daily sampling during the MID and POST surveys showed an increase in free ammonia and nitrite nitrogen as the water passed through the lake.

Total phosphorus values declined from the PRE survey values of about 0.037 ppm to .018 ppm during the MID survey but increased to PRE season levels during the POST survey. A drop in total phosphorus content as the water passed through Lovesick Lake was noted during the MID survey; no such decrease was noted during the POST survey. This decrease during the MID survey may be due to favourable conditions for the growth of phyloplankton.

Calcium and alkalinity remained at the same levels during the first two surveys but decreased about 5 ppm to a value of 31 ppm and 3 ppm to 77 ppm, respectively, during the POST survey.

Conductivity values averaged 200, 185 and 190 micromhos per cm^3 during each survey, respectively.

Stony Lake - Western Section

Values of free ammonia and nitrite nitrogen showed the same variance found in Lovesick Lake during the PRE survey. Alkalinity, calcium and conductivity similarly reflected the influence of Lovesick Lake. A relatively high conductivity was found at Juniper Point.

Since sampling during the remaining two surveys was limited, no further comments are made on the quality as it passed through this section.

Stony Lake - Eastern Section

In contrast with Lovesick Lake, the free ammonia nitrogen concentration during the PRE survey remained generally uniform through this section at about .05 ppm. During the MID and POST surveys, this parameter remained at .03 ppm. A gradual increase in total kjeldahl nitrogen occurred during the year. Alkalinity and calcium remained at approximately 72 and 30 ppm respectively during the first two surveys but was 2 to 3 ppm lower in the POST survey.

The conductivity values were approximately 165, 171 and 169 micromhos during each survey, respectively.

The average total phosphorus content rose from 0.012 ppm during the PRE survey to .016 ppm during the

MID survey and then declined to .010 ppm during the POST survey. A high concentration of soluble phosphorus (.016 ppm) just east of Irwin Inn was observed on August 3, a holiday weekend.

The daily chemical sampling revealed occasional high levels of nitrite nitrogen and total phosphorus during POST survey. The occasions correspond to inclement weather; as a result, the phosphorus may be due to mixing with the enriched bottom waters (the development of anaerobic conditions will result in increased nutrients in hypolimnetic waters) and/or surface runoff.

Stony Lake - Central Section

The free ammonia nitrogen concentrations during the PRE survey were generally uniform at approximately 0.05 ppm, reflecting the influence of eastern Stony Lake. The content remained at this level during the MID survey. During the POST survey, the free ammonia nitrogen in the middle of the lake (Station 40) was .03 ppm and was .01 ppm at McCrackens Landing.

The total phosphorus content was .021 ppm during the PRE survey and .015 ppm during the MID survey.

The alkalinity and calcium during the PRE and MID surveys were 80 and 34 ppm, respectively. A small decline to 76 and 31 ppm, respectively, occurred during

the POST survey; this decline was also found in upstream sections of the lake system.

Except during the MID survey, the conductivity in this section reflected the mixing of waters from Lovesick Lake and eastern Stony Lake. The values during the PRE season averaged 190 micromhos per cm^3 and 187 during the MID and POST surveys.

Occasional high conductivities were found during the PRE survey e.g. along the south shore near McCrackens Landing and once during the MID survey at Mount Julian. These findings coupled with the higher total phosphorus values at the same points suggest the influence of waste inputs.

A comparison of the bottom water samples collected at Stations 38 and 65 during the PRE survey with surface samples shows no appreciable difference in chemical quality. Since no increase in certain chemical constituents such as phosphorus and iron was observed (a release of these chemicals from bottom muds occurs during anoxic conditions), then it was concluded pronounced stratification accompanied by oxygen depletion in the bottom waters had not occurred during the PRE survey.

Clear Lake

The concentrations of free ammonia nitrogen decreased from approximately 0.05 ppm during the PRE survey to less than 0.01 ppm in the MID survey and then increased to .02 to .03 ppm in the fall. Nitrite concentrations of some 0.011 ppm found in the PRE survey declined to approximately 0.002 ppm and remained at that value during the MID and POST surveys.

Total phosphorus concentrations tended to remain at the same levels during all surveys. However,

the sampling conducted on 10 days during the fall survey show an increase in total phosphorus from 0.023 to 0.032 ppm as the water passed through Clear Lake.

A slight increase in alkalinity (from 80 to 83 ppm) and calcium (from 34 to 36 ppm) occurred from PRE to MID surveys; these values dropped during the POST survey.

The daily sampling during the POST survey revealed increases not only of phosphorus but also of hardness, alkalinity (from 76 to 81 ppm), calcium (from 31 to 33 ppm) and conductivity (from 187 to 194 micromhos per cm^3) as the water passed through the lake.

Conductivity rose from approximately 190 micromhos per cm^3 during the PRE survey to 202 micromhos per cm^3 during the MID survey. The conductivity then declined to approximately PRE survey values during the POST survey.

DISCUSSION

Conductivity: The conductivity values found in the various lake sections during each survey may be averaged as follows:

LOCATION	PRE SURVEY	MID SURVEY	POST SURVEY
Lovesick Lake	200	185	190
Western Stony Lake	200	-	187
Eastern Stony Lake	165	171	169
Central Stony Lake	190	187	187
Clear Lake	190	202	190

During the PRE survey, the conductivity in central Stony Lake and Clear Lake can be attributed to the combining of flows from Lovesick Lake (major contributor) and eastern Stony Lake.

However, during the MID survey, the conductivity in Clear Lake was much higher than in any of the incoming flows. Further, the conductivity in central Stony Lake was approximately at the same level as in Lovesick Lake, despite the influence of eastern Stony Lake. During the POST survey, a somewhat similar conductivity situation was evident, although not as pronounced. No explanation for this phenomenon is presently available.

Productivity: Although productivity studies were not conducted, the chemical data does give some indications in this regard.

The waters in eastern Stony Lake exhibited consistently lower conductivities and alkalinities (up to 10 ppm lower) than in the other sections of this lake system, particularly Lovesick and Clear Lakes. Sparling and Nalewajko in their study of the "Chemical Composition and Phytoplankton of Lakes in Southern Ontario" show productivity has a direct relationship to conductivity and alkalinity. The concentrations of total kjeldahl nitrogen and total phosphorus were also consistently lower.

The foregoing data suggest that eastern Stony Lake is the least productive of all lake sections in this area.

Nutrient Surges: The daily chemical sampling conducted in the fall revealed two main upward increases particularly in total kjeldahl nitrogen and total phosphorus concentrations.

One of these surges occurred on or about September 15, at which time there was precipitation. Hence, the increase, which occurred throughout most of the system, can be attributed to surface runoff which will carry contaminants originating from natural causes and from the activities of main (for example, sewage disposal systems) into the lake system. It is noted that, at the same time, there was a corresponding increase in the total coliform counts.

Another marked increase occurred on or about September 19. Although more promienent in the Trent Canal channel, the increase was also evident in Stony Lake east of the main navigation channel. No explanation for this phenomenon is presently available. At this time, the bacterial picture was the opposite, namely, the total coliform count decreased significantly.

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REFERENCES

BURGER, C.A. October, 1970. Bacteriological Water Quality of Lovesick, Clear and Stony Lakes - Ontario Water Resources Commission, Division of Laboratories, Bacteriology Branch Internal report.

SPARLING, J.H. and NALEWAJKO, C. 1970. Chemical Composition and Phytoplankton of Lakes in Southern Ontario. J. Fish. Res. Bd. Canada 27:1405-1428

LOVESICK LAKE

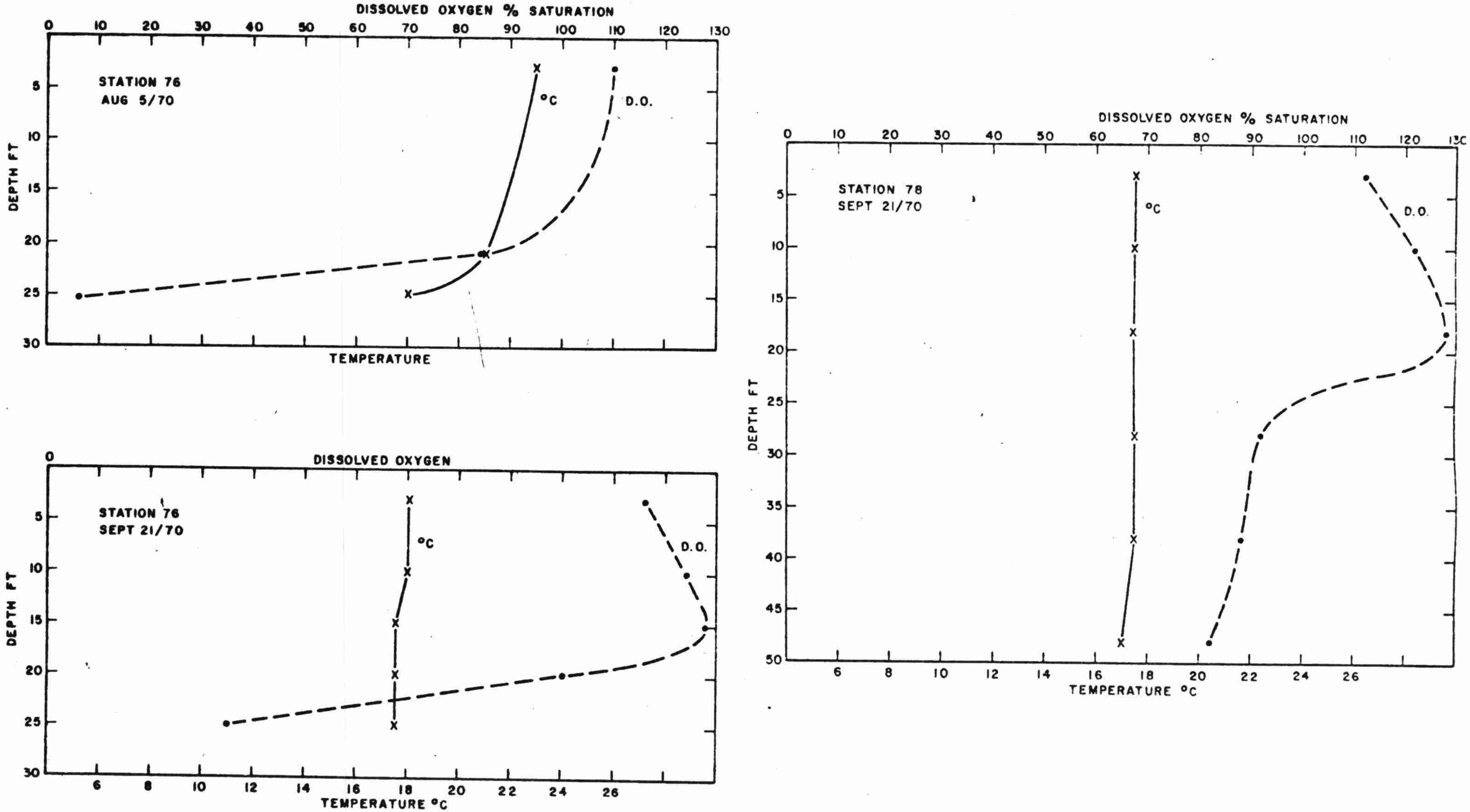
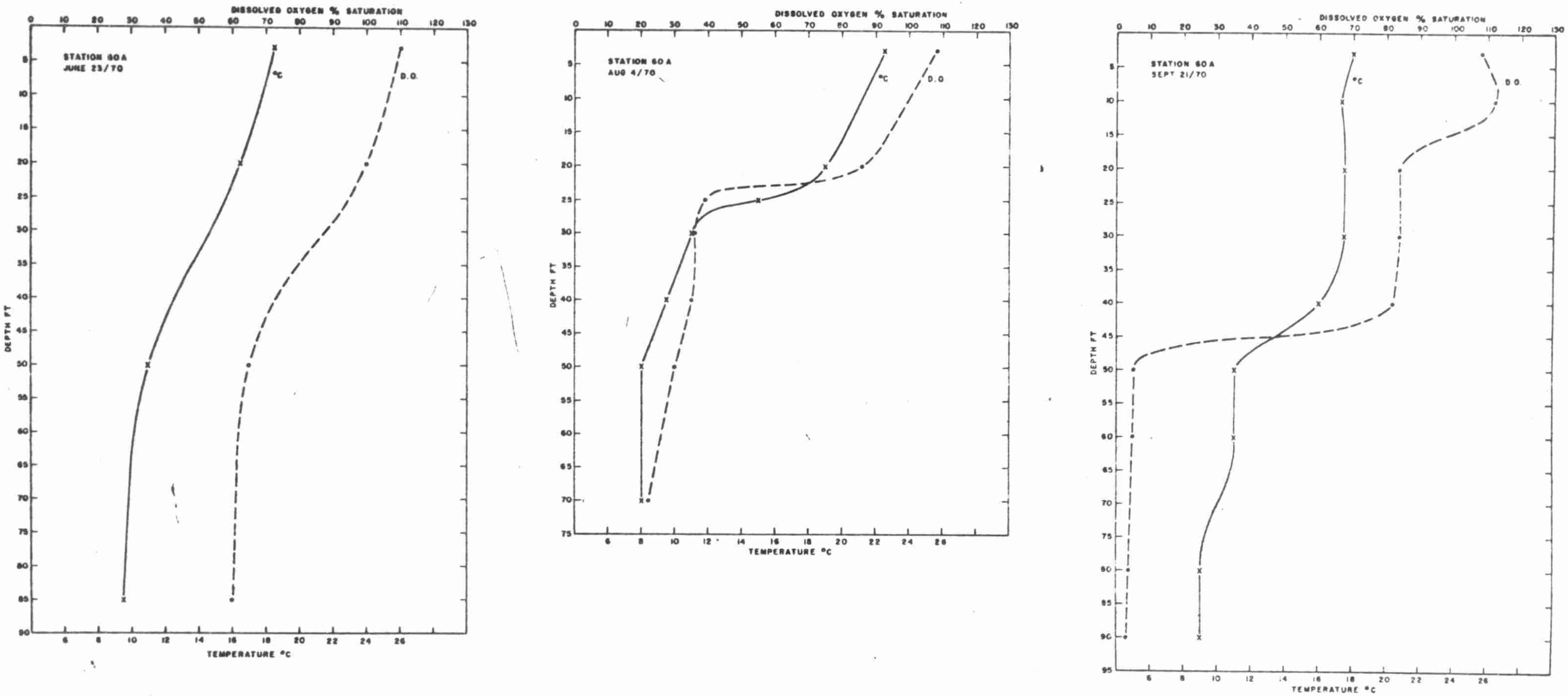
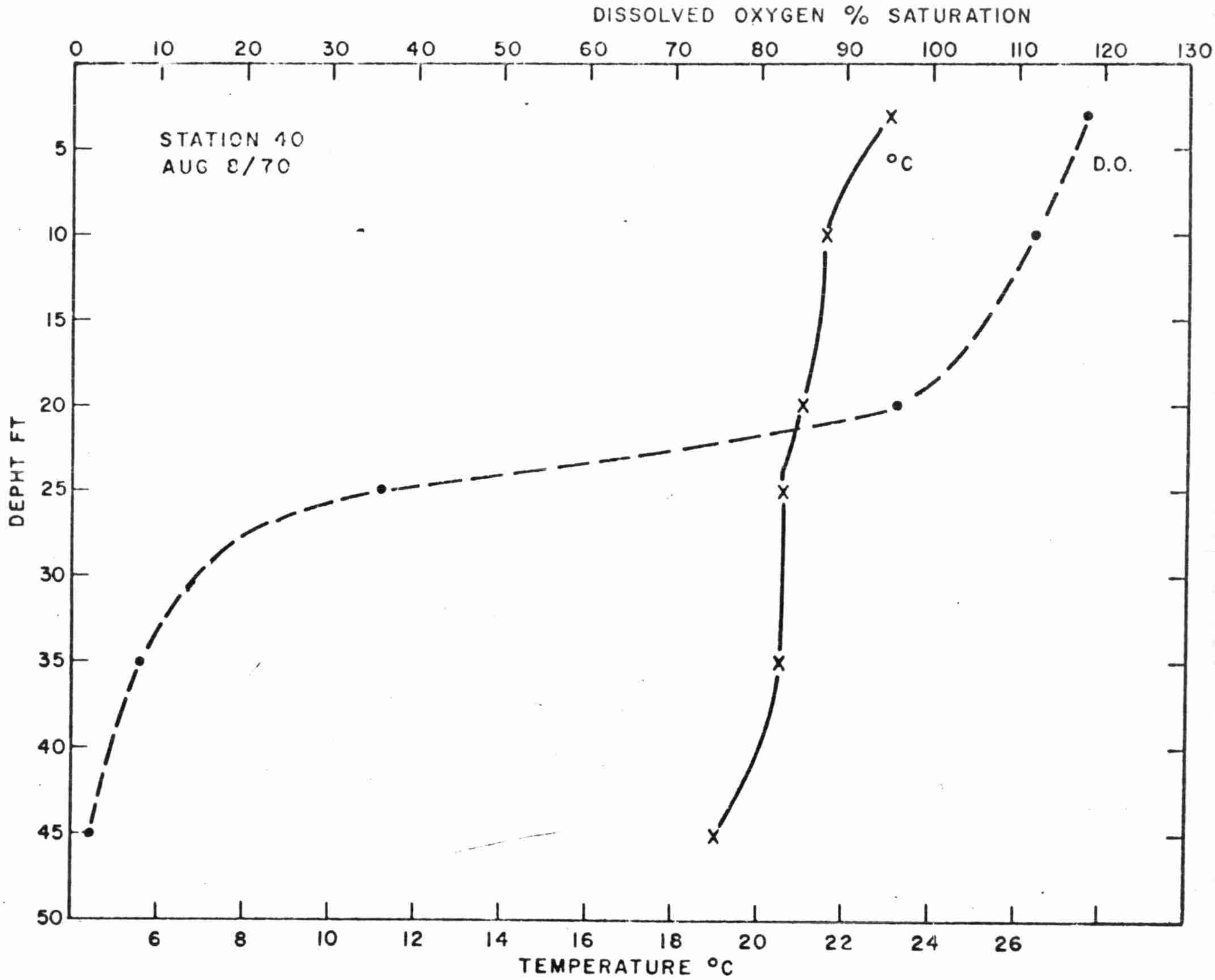


FIGURE 1



STONY LAKE - EASTERN SECTION

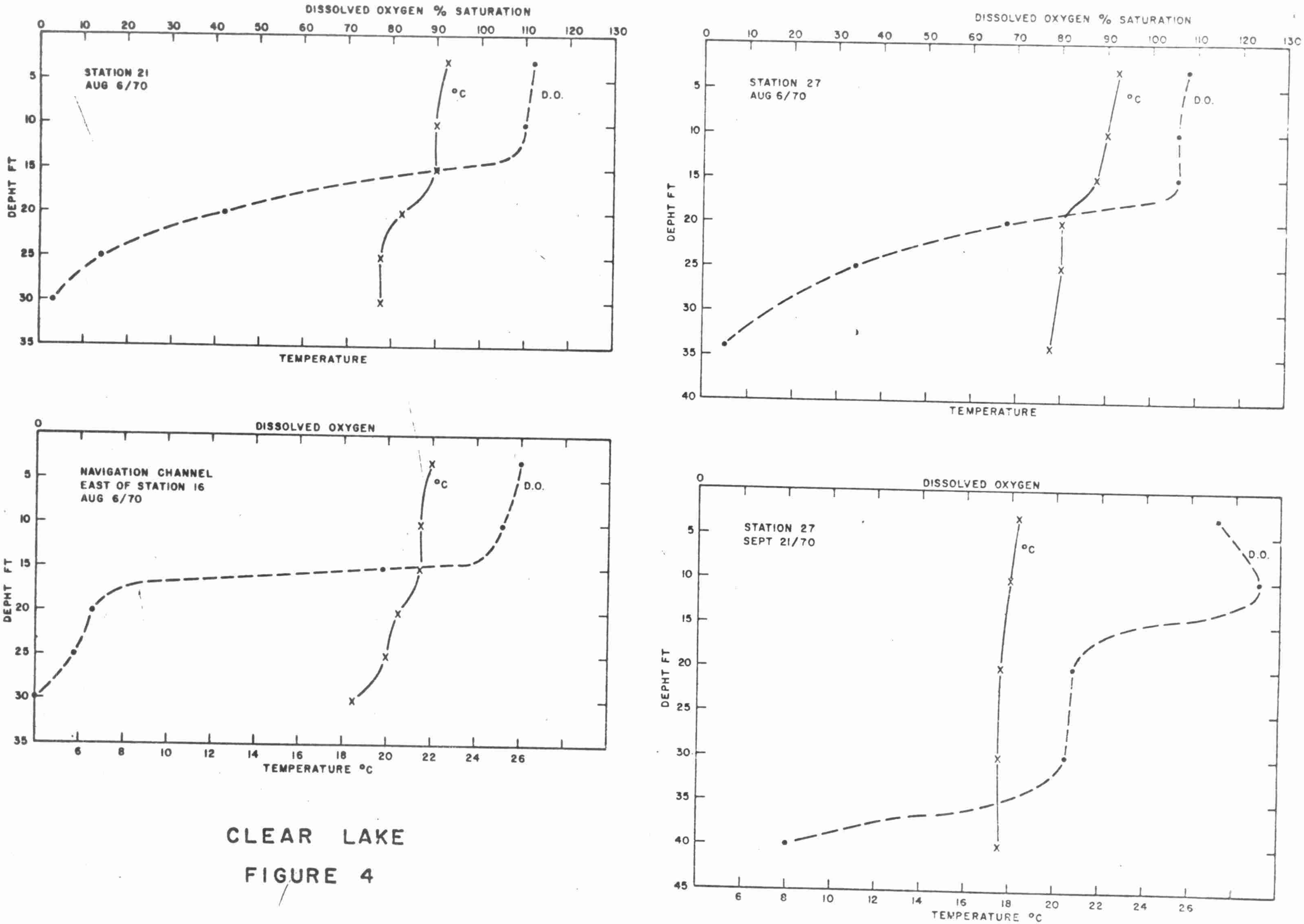
FIGURE 2



STATION 40

STONY LAKE - CENTRAL SECTION

FIGURE 3



CLEAR LAKE

FIGURE 4

TABLE I

WEATHER CONDITIONS DURING SAMPLING

DATE 1970	AIR TEMPERATURE (°C) Avg.	Range	WIND Direction (°N)	Velocity (mph)	COMMENTS
July 19	16	15 - 17.5	280	10	
20	13	11 - 16	320	7	
21	23	19 - 27	90	3	
22	26	23 - 28	270	3	
23	23	29 - 18	270	3	
24	20	24 - 14	---	nil	
25	20	15 - 28	---	nil	
26	27	28 - 25	220	12	
27	23	21 - 25	360	5	
28	23	20 - 26	---	nil	
29	17	16 - 18	200	15	Data for Clear Lake Only
July 31	25	24 - 28	---	nil	Rain during previous night
Aug. 1	24	23 - 24	---	nil	
2	21	19 - 24	290	7	
3	21	21	260	10	
4	--	--	340	3	
5	19	--	---	nil	
6	19	15 - 23	---	nil	
7	20	18 - 24	---	nil	
8	26	19 - 32	---	nil	
9	24	19 - 28	---	nil	
10	24	18 - 28	40	2	
Sept. 11	21	20 - 22	285	10	
12	19	14 - 23	180	5	
13	17	14 - 18	270	5	
14	14	10 - 18	40	5	
15	14	13 - 15	90	5	Rain
16	18	17 - 18	300	15	
17	13	9 - 15	100	3	
18	16	14 - 18	100	5	
19	16	13 - 25	330	5	
20	20	14 - 25	---	nil	
21	23	17 - 27	290	7	

TABLE II

LOVESICK LAKE

June 19 - 29, 1970
July 31 - Aug. 10, 1970
Sept. 11 - 21, 1970

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
78	38	5	3	7	110	20.7
	1387	43 -(9)	30	11	106	22.5
	1708 (10)	3	11	11	100	17.4
77	59	6	9	7	103	21.3
	1900	144 (4)	9	6	104	23.5
	978	7	7	4	97	17.9
79	34	3	6	7	107	20.2
	1966	48 (4)	27	6	103	23.4
	551	7	2	4	97	18.0
80	24	8	5	7	107	20.3
	1382	38 (4)	18	6	105	23.4
	743	7	1	4	99	18.0
81	26	3	4	7	110	20.3
	1203	44 (4)	14	6	102	23.7
	1011	2	2	4	100	18.2
76	33	3	2	7	104	20.7
	1321	37 (5)	5	6	107	23.3
	1930	3	2	11	96	17.7
76D	27	4	2	5	65	19.5
	1095	20	7	6	---	----
	1872	1	2	8	84	17.9
75	48	8	6	7	107	20.5
	1274	61 (4)	7	6	109	23.3
	3494 (3)	4	3	4	97	18.3

TABLE II (Cont'd)

LOVESICK LAKE

STATION	GEOMETRIC MEAN PER 100 ML				DISS.	TEMPERATURE
	TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	OXYGEN % SAT.	°CENT.
74	52	24	5	7	103	20.9
	1306	100 (4)	8	6	111	23.3
	2514	5	2	4	100	18.0
73	40	12	10	7	103	21.8
	1374	91 (4)	11	6	110	23.8
	1200	10	7	3	108	17.7
72	29	10	6	7	111	20.8
	1647	102 (4)	18	6	105	23.2
	1465	6	6	4	98	17.8
82	24	5	21	7	108	20.3
	1520	36 (5)	89	6	105	23.3
	1290	3	13	4	99	17.9
83	36	7	6	7	106	20.1
	1550	30 (9)	18	11	103	22.6
	2129	3	8	11	95	17.6

NOTE: Figure in brackets denotes number of observations if different from that of remaining bacterial parameters.

TABLE II

STONY LAKE - WESTERN SECTION

June 19 - 29, 1970
July 31 - Aug. 10, 1970
Sept. 11 - 21, 1970

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
1	114	16	31	7	93	18.8
	1204	107 (5)	96	6	96	23.2
	1637	21	31	4	94	17.4
2	51	12	69 (5)	6	99	19.3
	3437	109	210 (5)	4	96	23.3
	2298	3	86	9	95	17.3
3	75	20	15	6	101	19.0
	2603 (5)	124	108	6	96	23.4
	2019	6	20	4	99	17.5
4	38	6	25	7	102	18.8
	1836 (10)	71 (9)	30	11	100	22.9
	1831	6	10	11	100	17.5
5	39	6	12	7	103	19.0
	2119	96 (9)	49	11	98	29.4
	2136	6	8	11	99	17.6
6	48	10	21	7	102	19.0
	1743	132	56	10	97	23.0
	1727	9	13	11	97	17.6
7	48 (6)	13	33	5	110	19.1
	1587	88 (5)	5	6	105	22.8
	785	8	2	4	104	17.4
8	41	11	29	6	108	18.5
	640	120	12 (6)	5	100	22.5
	925	8	3	3	97	17.3

TABLE II (CONT'D)

STONY LAKE - WESTERN SECTION

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
9	50	8	37	6	104	18.0
	1017	86 (5)	7	6	102	23.0
	768	8	2	3	100	17.2
10	40	4	90	6	106	18.3
	972	22 (5)	17	6	104	22.8
	623	15	7	3	99	17.0
11	57	5	79	6	104	18.6
	1854	38 (5)	21	6	105	22.5
	408	3	10	3	99	17.0
12	110	6	24	6	109	18.5
	628	29	4	6	103	22.5
	2482 (2)	4	2	3	98	17.0
84	98	6	20	4	106	18.7
	559	45	4	6	102	22.8
	2747	14	2	3	99	17.0

NOTE: Figure in brackets denotes number of observations if different from that of remaining bacterial parameters.

TABLE II

STONY LAKE - CENTRAL & EASTERN SECTIONS

June 19 - 29, 1970
July 31 - Aug. 10, 1970
Sept. 11 - 21, 1970

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
53	19	2	11	6	103	18.5
	460	8	2	6	106	22.4
	108	1	3	4	99	17.5
54	25	3	20	6	103	19.4
	463	3	3	6	107	22.5
	114	2	2	3	101	17.8
55	33	2	17	6	103	19.4
	466	9	20	6	108	23.0
	116	1	13	4	98	17.8
56	55	8	37	6	104	19.5
	715	15	17	6	104	22.8
	172	4	1	1	95	18.0
57	42	3	9	6	103	19.5
	596	16	36	6	109	22.5
	116	1	1	1	94	17.8
58	35	4	19	6	103	19.8
	589 (5)	21	4	6	108	22.8
	94	2	4	4	97	17.6
59	24	2	16	6	103	19.4
	550 (5)	50	40	6	106	23.2
	134	2	10	7	97	17.8
59A	--	-	---	-	---	----
	501	16	8 (3)	4	---	----
	--	-	---	-	---	----

TABLE II (Cont'd)

STONY LAKE - CENTRAL & EASTERN SECTIONS

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
59B	--	-	-	-	---	----
	382	13	11 (3)	4	---	----
	--	-	-	-	---	----
60	42	2	10	6	100	19.2
	301 (5)	19	17	6	106	23.0
	106	2	3	10	95	17.9
60A	26	1	1	4	---	----
	539	33	1	6	---	----
	--	-	-	-	---	----
60B	46	1	1	4	---	----
	331	41	2	6	---	----
	--	-	-	-	---	----
61	27	3	3	6	104	19.3
	381 (5)	17	2	6	107	22.8
	191	2	2	4	94	17.9
52	16	5	56	6	98	18.9
	565	14	2	6	109	22.8
	196	3	4	3	102	17.8
51	144	93	95	6	95	18.9
(Jack	2387	176 (6)	388	5	94	22.3
Creek)	823	16	348	3	92	17.2
50	25	2	2	6	104	18.9
	438	12	2	6	111	23.2
	149	2	1	3	97	17.8
49	75	12	19	6	96	18.4
(Eels	2172 (5)	39	18	6	97	21.9
Creek)	432	7	8	3	95	17.1
48	36	2	1	6	105	18.5
	765	67	3	6	108	22.6
	169	2	1	3	92	18.1
47	40	2	3	6	103	18.6
	665	15	3	6	103	22.6
	291	3	2	4	92	18.1

TABLE II (Cont'd)

STONY LAKE - CENTRAL & EASTERN SECTIONS

STATION	GEOMEGRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
46	46	2	5	6	85	18.3
	371	14	2	6	106	22.8
	190	9	2	3	97	17.3
43	49	3	2 (10)	11	109	18.0
	421	35	1	11	109	22.7
	153	4	2	11	92	17.8
44	32	1	1	11	104	18.2
	414	46 (10)	2	11	107	22.8
	156	4	2	11	91	17.7
44D	52	1	1	10	46	11.2
	558 (10)	12	1	11	---	----
	153	2	1	8	4.6	10.6
45	42	2	2	11	104	18.3
	624	44 (10)	2	11	110	22.8
	192	3	1	11	94	17.8
42	75	2	4	6	101	18.3
	530	23	4	6	109	22.8
	276	40	0	1	84	17.8
64	50	11	30	6	102	19.6
	405	28	3	6	106	22.4
	--	-	-	-	---	----
63	34	1	17	6	102	19.2
	115	14	1	6	114	22.5
	656	6	2	4	107	18.1
62	36	2	6	6	105	19.8
	125	3	3	6	113	22.7
	320 (3)	6	2	4	108	18.0
41	59	3	4	6	101	18.5
	569	32 (5)	3	6	109	23.0
	--	-	-	-	---	----
37	50	3	5	11	103	18.9
	576	12 (9)	4	11	111	23.1
	2114 (9)	7	2	11	103	18.3

TABLE II (Cont'd)

STONY LAKE - CENTRAL & EASTERN SECTIONS

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
38	66	2	2	11	100	18.9
	364	22 (9)	2	11	111	22.7
	2275 (9)	6	1	11	100	18.0
38D	108	1	2	9	15	17.3
	359	3	1	11	---	----
	3524 (6)	5	1	7	---	----
39	59	1	2	11	102	18.5
	508	11 (9)	4	11	108	22.6
	2083 (8)	4	1	11	103	18.2
40	55	1	2	11	101	18.9
	503	15 (10)	2	11	107	22.6
	1030	5	1	11	102	18.1
36	80	6	24	6	88	18.5
	597	42	4	6	108	23.2
	--	-	-	-	---	----
65	58	3	2	6	98	19.2
	278	60 (5)	4	6	107	22.7
	392	5	1	3	107	17.8
68		6	7	11	101	18.6
	550	144 (8)	9	11	108	22.8
	893	10	3	10	101	17.7
67	63	1	2	11	101	18.6
	287	30 (7)	3	11	110	22.8
	1369	5	2	4	105	17.6
66	79	3	2	11	94	18.5
	316	58 (9)	2	11	108	22.8
	837 (5)	4	2	6	104	17.9
69	67	6	15	6	98	18.6
	742	115 (5)	15	6	105	22.6
	618	5	2	4	107	17.5
70	91	13	30	6	98	18.7
	764	173 (5)	14	6	108	22.5
	170 (1)	14	3	2	103	18.0

TABLE II (Cont'd)

STONY LAKE - CENTRAL & EASTERN SECTIONS

STATION	GEOMETRIC MEAN PER 100 ML				DISS.	TEMPERATURE
	TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	OXYGEN % SAT.	° CENT.
71	39	8	28	5	116	18.5
	1172	77	20	3	111	22.8
	--	-	-	-	---	----

NOTE: Figure in brackets denotes number of observations

if different from that of remaining bacterial parameters.

TABLE II

CLEAR LAKE

June 19 - 29, 1970
July 31 - Aug. 10, 1970
Sept. 11 - 21, 1970

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
13	62	10	15	5	109	19.0
	715	44	10	6	105	22.8
	180	6	2	1	---	----
14	51	11	18	11	114	18.7
	994	33	5	11	111	22.7
	842	6	3	10	98	17.1
15	67	3	3	11	105	19.1
	372	17	3	11	115	22.6
	1561	5	1	10	99	17.8
16	63	4	3	11	107	19.4
	328	12	3	11	112	22.4
	1909	9	2	10	99	17.6
35	39	4	5	6	105	19.2
	537	17	10	6	114	23.2
	--	-	-	-	---	----
17	49	2	2	6	101	20.0
	351	24	4	6	113	23.0
	1924	6	1	3	100	17.5
18	41	3	3	6	99	19.4
	465	21	6	6	109	23.0
	--	-	-	-	---	----
19	79 (5)	3	3	6	97	19.3
	356	14	7	6	110	22.8
	1460	10	3	3	99	17.3

TABLE II (Cont'd)

CLEAR LAKE

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE ° CENT.
20	60	2	2	11	103	19.3
	296	16	3	11	115	22.6
	1743	3	5	3	98	17.3
21	64	3	1	11	106	19.5
	162 (10)	11	2	11	113	23.2
	1451	1	1	10	102	17.8
21D	96	2 (10)	1	9	13	16.8
	281	3	1	11	---	----
	1613	1	1	7	91	18.5
22	54	4	2	11	104	19.0
	513	63	7	11	112	23.3
	1110	6	3	4	103	18.0
23	67	2	2	6	107	19.1
	554	9 (4)	6	6	114	23.3
	--	-	-	-	---	----
24	80	3	2	6	98	19.8
	689	9 (5)	2	4	110	23.2
	--	-	-	-	---	----
25	132	3	2	11	97	19.1
	335	35 (10)	3	11	113	23.0
	1400	6	2	3	---	----
26	98	2	1	11	98	19.2
	255 (9)	14 (10)	2	11	114	22.9
	--	-	-	-	---	----
27	79	1	1	11	103	18.8
	204	12	2 (11)	10	114	23.0
	--	-	-	-	---	----
28	103	3	2	11	104	19.0
	600	18 (9)	5	11	112	23.1
	1839	5	2	3	---	----
29	121	2	2	6	100	19.5
	567	5 (4)	5	6	116	23.2
	--	-	-	-	---	----

TABLE II (Cont'd)

CLEAR LAKE

STATION	GEOMETRIC MEAN PER 100 ML TOTAL COLIFORMS	FECAL COLIFORMS	FECAL STREP.	NO. OBSERV.	DISS. OXYGEN % SAT.	TEMPERATURE °CENT.
30	190	3	3	6	93	19.5
	374	10	3	6	118	23.2
	--	-	-	-	---	----
31	117	2	3 (11)	10	97	19.4
	480	14 (10)	3	11	114	22.8
	1089 (9)	2	2	10	99	18.1
32	154	1	2	11	98	19.5
	199	12 (10)	2	11	114	23.0
	1084	4	1	10	98	18.1
33	162	2	1	11	97	19.4
	167 (10)	11	2	11	113	22.9
	1502 (9)	2	1	10	97	18.2
34	146	3	1	11	97	19.4
	292	15	3 (11)	10	113	23.1
	1358	3	2	10	100	17.9

NOTE: Figure in brackets denotes number of observations if different from that of remaining bacterial parameters.

TABLE III

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

June 19 - 29, 1970

SAMPLING POINT	DATE	NITROGEN AS N: FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P: TOTAL	SOLUBLE	IRON As Fe
78	June 20/70	0.11	.54	.004	<0.01	.034	.005	.10
76	June 19/70	.05	.66	.003	<.01	.064	.004	0.10
76D	June 19/70	.18	.78	.005	<.01	.028	.005	0.20
79	June 21/70	0.07	.50	.005	0.02	.024	.014	.35
75	June 25/70	.05	.37	.004	<.01	.022	.003	trac
72	June 22/70	0.15	.71	.005	<0.01	.028	.004	trace
83	June 25/70	.09	.48	.004	<.01	.024	.004	trace
1	June 25/70	.04	.72	.005	<.01	.044	.004	trac
2	June 20/70	0.11	.50	.008	0.01	.031	.017	.10
	June 28/70	.01	.63	.014	.01	.02	.002	trac
5	June 25/70	.07	.60	.006	<.01	.044	.004	.10
7	June 22/70	0.10	.52	.002	<0.01	.027	.012	.05
84	June 26/70	.08	.64	.006	<.01	.044	.003	trac
14	June 21/70	0.07	.49	.007	0.03	.018	.008	2.20
	June 29/70	0.02	.60	.013	<.01	.023	.002	trac
15	June 26/70	.08	.59	.007	<.01	.029	.003	trac
16	June 28/70	.03	.57	.016	<.01	.027	.002	trace
19	June 25/70	.05	.53	.006	.02	.018	.002	trac
21	June 28/70	.04	.63	.017	.02	.025	.002	.20
	June 29/70	.04	.52	.014	.01	.023	.002	trac

TABLE III

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

June 19 - 29, 1970

SAMPLING POINT	DATE	NITROGEN AS N: FREE AMMONIA	NITROGEN AS N: TOTAL KJELDAHL	NITROGEN AS N: NITRITE	NITROGEN AS N: NITRATE	PHOSPHORUS AS P: TOTAL	PHOSPHORUS AS P: SOLUBLE	IRON As Fe
78	June 20/70	0.11	.54	.004	<0.01	.034	.005	.10
76	June 19/70	.05	.66	.003	<.01	.064	.004	0.10
76D	June 19/70	.18	.78	.005	<.01	.028	.005	0.20
79	June 21/70	0.07	.50	.005	0.02	.024	.014	.35
75	June 25/70	.05	.37	.004	<.01	.022	.003	trace
72	June 22/70	0.15	.71	.005	<0.01	.028	.004	trace
83	June 25/70	.09	.48	.004	<.01	.024	.004	trace
1	June 25/70	.04	.72	.005	<.01	.044	.004	trace
2	June 20/70	0.11	.50	.008	0.01	.031	.017	.10
	June 28/70	.01	.63	.014	.01	.02	.002	trace
5	June 25/70	.07	.60	.006	<.01	.044	.004	.10
7	June 22/70	0.10	.52	.002	<0.01	.027	.012	.05
84	June 26/70	.08	.64	.006	<.01	.044	.003	trace
14	June 21/70	0.07	.49	.007	0.03	.018	.008	2.20
	June 29/70	0.02	.60	.013	<.01	.023	.002	trace
15	June 26/70	.08	.59	.007	<.01	.029	.003	trace
16	June 28/70	.03	.57	.016	<.01	.027	.002	trace
19	June 25/70	.05	.53	.006	.02	.018	.002	trace
21	June 28/70	.04	.63	.017	.02	.025	.002	.20
	June 29/70	.04	.52	.014	.01	.023	.002	trace

TABLE III (Cont'd)

STONY, CLEAR & LOVESICK LAKES - June 19 - 29/70

SAMPLING POINT	DATE	NITROGEN AS N FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P TOTAL	SOLUBLE	IRON As Fe
21D	June 19/70	.05	.53	.004	.05	.010	.002	0.15
24	June 27/70	.04	.40	.016	.02	.061	.004	trace
27	June 21/70	0.08	.38	.002	<0.01	.013	.008	trace
28	June 29/70	.05	.54	.014	.01	.023	.002	trace
30	June 28/70	.01	.50	.014	.01	.02	.002	trace
54	June 23/70	0.06	.37	.004	0.01	.011	.009	.05
50	June 24/70	.04	.47	.006	.03	.01	.002	trace
60	June 27/70	.03	.27	.014	.01	.009	.002	trace
60A	June 23/70	.04	.35	.007	.15	.02	.004	trace
43	June 20/70	0.07	.31	.005	0.02	.011	.010	.10
37	June 26/70	.07	.58	.006	<.01	.021	.004	trace
38D	June 19/70	.06	.34	.004	.04	.013	.002	0.10
65	June 27/70	.03	.36	.014	.01	.017	.002	trace
65D	June 23/70	0.05	.41	.005	0.03	.014	.008	.05
68	June 20/70	0.07	.43	.003	<0.01	.017	.012	.05
69	June 26/70	.06	.46	.008	.01	.021	.002	trace
70	June 23/70	0.07	.42	.006	0.02	.015	.006	.05
71	June 27/70	.04	.48	.018	.02	.036	.004	trace

TABLE III

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

June 19 - 29, 1970

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromho per cm^3
78	June 20/70	8.5		83	37	5	5	12	209
76	June 19/70	9		80	37	6	5	3.5	190
76D	June 19/70	8		80	35	5	5	1.5	189
79	June 21/70	7		81	36	7	5	6	209
75	June 25/70	8		83	36	3	5	3	198
72	June 22/70	7		82	34	4	6	2	197
83	June 25/70	8.5		83	36	3	5	3	200
1	June 25/70	8		83	35	2	6	3	199
2	June 20/70	6.5		81	36	6	6	4	209
	June 28/70	7		82	35	2	5	2	196
5	June 25/70	9		80	35	2	6	4	198
7	June 22/70	9.5		81	36	6	6	6	209
84	June 26/70	7		79	35	2	5	3	192

TABLE III (Cont'd)

STONY, CLEAR & LOVESICK LAKES - June 19 - 29/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3
14	June 21/70	8		80	35	4	6	8	204
	June 29/70	7.5		79	34	2	4	3	185
15	June 26/70	7		79	34	2	5	2.	191
16	June 28/70	7.5		79	34	2	5	1.5	187
19	June 25/70	7		79	34	3	5	3	188
21	June 28/70	7		80	34	2	5	1	189
	June 29/70	7		80	34	-	4	2	189
21D	June 19/70	5.5		77	34	1	5	1.0	192
24	June 27/70	5		81	34	2	4	1	189
27	June 21/70	7		80	35	7	6	6	204
28	June 29/70	7.5		80	34	2	4	2	189
30	June 28/70	8		80	34	2	4	1	188
54	June 23/70	7.5		73	32	5	5	6	176
50	June 24/70	7		72	30	2	4	2	165
60	June 27/70	8		73	35	2	4	1	165
60A	June 23/70	7		69	29	2	4	> 300	164

TABLE III (Cont'd)

STONY, CLEAR & LOVESICK LAKES - June 19 - 29/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromohos per cm^3
43	June 20/70	7		72	31	5	5	3	177
37	June 26/70	7.5		98	34	2	5	2	186
38D	June 19/70	7		76	34	2	5	2.5	183
65	June 27/70	6.5		77	34	2	4	1	185
65D	June 23/70	7.5		78	34	6	5	3	197
68	June 20/70	7		78	34	7	5	4	198
69	June 26/70	8		79	34	2	5	2	186
70	June 23/70	7		78	36	5	6	6	197
71	June 27/70	9		78	34	2	5	1.5	187

TABLE IV

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

July 31 - Aug. 10, 1970

SAMPLING POINT	DATE	NITROGEN AS N FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P TOTAL	SOLUBLE	IRON As Fe
78	Aug. 5/70	0.01	.48	.009	< 0.01	.035	.004	0.10
	Aug. 6/70	0.09	.51	.004	.01	.016	.008	.15
	Aug. 7/70	0.06	.37	.002	<.01	.016	.002	.15
	Aug. 8/70	0.02	.40	.002	<.01	.021	.001	.10
	Aug. 9/70	0.01	.35	.002	<.01	.023	.004	.15
	Aug. 10/70	<.01	.40	.002	<.01	.022	.001	.15
83A	Aug. 5/70	0.01	.50	.009	<0.01	.028	.004	0.10
	Aug. 6/70	0.07	.45	.002	< 0.01	.017	.016	.20
	Aug. 7/70	0.06	.39	.002	< 0.01	.014	.002	.15
	Aug. 8/70	0.02	.40	.002	.01	.014	.003	.15
	Aug. 9/70	0.01	.35	.002	<.01	.015	.002	.10
	Aug. 10/70	0.01	.38	.002	<.01	.016	.001	.10
78	Aug. 5 - 10/70							
	Minimum	<.01	.35	.002	<.01	.016	.001	.10
	Maximum	.09	.51	.009	.01	.035	.008	.15
	Median	.02	.40	.002	<.01	.022	.003	.15
83A	Aug. 5 - 10/70							
	Minimum	.01	.35	.002	<.01	.014	.001	.10
	Maximum	.07	.50	.009	.01	.028	.016	.20
	Median	.02	.40	.002	<.01	.016	.003	.13
15	Aug. 6/70	<0.01	.57	.002	0.01	.026	.006	0.05
22	Aug. 6/70	<0.01	.41	.002	0.01	.022	.004	0.05
29	Aug. 6/70	<0.01	.41	.002	0.02	.025	.006	0.05
32A	Aug. 6/70	<0.01	.43	.002	0.01	.012	.004	0.30
52	Aug. 7/70	.03	.40	.002	<.01	.018	.004	.35
51	Aug. 3/70	0.01	.36	0.010	0.01	.014	.004	.20
59B	Aug. 3/70	0.06	.41	0.040	0.04	.021	.016	.05

TABLE IV (Cont'd)

STONY, CLEAR & LOVESICK LAKES - July 31 - Aug. 10/70

SAMPLING POINT	DATE	NITROGEN AS N FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P TOTAL	SOLUBLE	IRON As Fe
60A	Aug. 3/70	0.01	.30	0.012	0.29	.025	.010	.20
43	Aug. 5/70	0.01	.37	.008	< 0.01	.016	.005	.10
44	Aug. 7/70	.03	.33	.002	<.01	.009	.002	.10
45	Aug. 5/70	0.01	.36	.010	<0.01	.011	.005	.90
40	Aug. 5/70	0.06	.46	.010	<0.01	.011	.004	.10
37	Aug. 5/70	0.01	.46	.009	<0.01	.022	.006	.05
38	Aug. 7/70	.05	.35	.002	<.01	.014	.002	.10
67	Aug. 7/70	.03	.39	.002	<.01	.012	.002	.10

TABLE IV

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

July 31 - Aug. 10, 1970

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3
78	Aug. 5/70	11		79	35	1	5	3	199
	Aug. 6/70	10.5		80	36	1	5	3	186
	Aug. 7/70	10		81	34	2	5	3	184
	Aug. 8/70	10.5		79	34	2	5	1.5	184
	Aug. 9/70	11		80	36	<1	4	3	183
	Aug. 10/70	9.5		80	36	<1	5	2	185
83A	Aug. 5/70	10.5		78	35	3	5	4	194
	Aug. 6/70	10		80	36	1	4	1.5	184
	Aug. 7/70	11		80	34	2	5	2	183
	Aug. 8/70	10.0		79	34	2	4	2	184
	Aug. 9/70	10.5		80	34	2	5	2	183
	Aug. 10/70	10.0		80	36	<1	5	3	184
78	Aug. 5 - 10/70								
	Minimum	9.5		79	34	<1	4	1.5	183
	Maximum	11.0		81	36	2	5	3	199
	Median	10.5		80	36	1	5	3	185
83A	Aug. 5 - 10/70								
	Minimum	10.0		78	34	<1	4	1.5	183
	Maximum	11.0		80	36	3	5	4	194
	Median	10.5		80	35	2	5	2	184

TABLE IV (Cont'd)

STONY, CLEAR & LOVESICK LAKES - July 31 - Aug. 10/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3
15	Aug. 6/70	11		82	36	1	9	2	200
22	Aug. 6/70	11		82	36	2	5	2	200
29	Aug. 6/70	9.5		84	36	1	6	3	203
32A	Aug. 6/70	11		84	36	1	6	3	203
52	Aug. 7/70	10.5		72	29	1	3	2	148
51	Aug. 3/70	9.5		75	32	0	3	3	169
59B	Aug. 3/70	8		71	31	1	4	4	174
60A	Aug. 3/70	8		69	31	1	4	6	174
43	Aug. 5/70	11.5		73	32	1	4	4	182
44	Aug. 7/70	8		76	32	1	4	4	169
45	Aug. 5/70	9.5		75	32	1	2	3	170
40	Aug. 5/70	11		82	32	1	4	4	181
37	Aug. 5/70	9.5		74	35	1	6	4	202
38	Aug. 7/70	10		81	35	1	4	2	186
67	Aug. 7/70	9.5		82	34	2	5	2	183

TABLE V

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

September 11 - 21, 1970

SAMPLING POINT	DATE	NITROGEN AS N FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P TOTAL	SOLUBLE	IRON As Fe
78	Sept. 11/70	.03	.52	.001	<.01	.024	.004	0.25
	Sept. 12/70	.02	.51	.001	<.01	.024	.002	0.20
	Sept. 13/70	.05	.56	.002	<.01	.028	.003	0.05
	Sept. 14/70	.06	.56	.002	<.01	.022	.003	0.05
	Sept. 15/70	.03	.49	.003	.007	.026	.003	0.05
	Sept. 16/70	.04	.71	.003	.007	.026	.003	0.05
	Sept. 17/70	.01	.43	.013	<.01	.017	.001	0.05
	Sept. 18/70	.02	.57	.002	<.01	.033	.004	trace
	Sept. 19/70	.04	.50	.003	.007	.032	.003	0.05
	Sept. 20/70	.02	.59	.003	.007	.050	.002	0.05
	Sept. 21/70	.01	.48	.003	.007	.035	.002	trace
78	Sept. 11 - 21/70							
	Minimum	.01	.43	.001	<.01	.017	.001	trace
	Maximum	.06	.71	.013	.007	.050	.004	.25
	Median (11)	.03	.52	.003	<.01	.026	.003	.05
2	Sept. 11/70	.03	.50	.002	<.01	.026	.004	0.25
	Sept. 12/70	.02	.47	.001	<.01	.028	.002	0.10
	Sept. 13/70	.05	.50	.004	<.01	.018	.004	0.05
	Sept. 14/70	.04	.48	.002	<.01	.028	.003	trace
	Sept. 15/70	.05	.55	.002	.008	.054	.003	0.05
	Sept. 16/70	.05	.53	.003	.007	.019	.003	trace
	Sept. 17/70	.04	.45	.002	<.01	.020	.004	0.05
	Sept. 18/70	.04	.46	.004	.02	.020	.002	0.05
	Sept. 19/70	.02	.55	.003	.007	.051	.002	0.05
	Sept. 20/70	.04	.55	.006	.004	.044	.010	0.05
	Sept. 21/70	.02	.46	.004	.006	.024	.002	0.05
2	Sept. 11 - 21/70							
	Minimum	.02	.45	.001	.004	.018	.002	trace
	Maximum	.05	.55	.006	.02	.054	.010	.25
	Median (11)	.04	.50	.003	.005	.026	.003	.05

TABLE V

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	NITROGEN AS N: FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P: TOTAL	SOLUBLE	IRON As Fe
60	Sept. 11/70	.03	.32	.001	.01	.008	.002	0.45
	Sept. 12/70	.03	.33	.002	<.01	.011	.002	0.10
	Sept. 13/70	.04	.35	.003	<.01	.018	.003	trace
	Sept. 14/70	.03	.35	.002	<.01	.019	.002	trace
	Sept. 15/70	.03	.35	.003	.017	.009	.002	trace
	Sept. 16/70	.03	.31	.004	.016	.007	.003	0.05
	Sept. 17/70	.01	.32	.013	.04	.021	.003	0.05
	Sept. 18/70	.02	.32	.003	.02	.010	.005	trace
	Sept. 19/70	.03	.37	.004	.016	.009	.001	0.05
	Sept. 21/70	.01	.33	.004	.006	.007	.001	trace
60	Sept. 11 - 21/70							
	Minimum	.01	.31	.001	<.01	.007	.001	trace
	Maximum	.04	.37	.013	.04	.021	.005	.10
	Median (10)	.03	.33	.003	.013	.010	.002	.05
44	Sept. 11/70	.03	.44	.001	.01	.014	.002	0.10
	Sept. 12/70	.03	.41	.001	.02	.009	.002	0.05
	Sept. 13/70	.04	.47	.002	<.01	.024	.002	0.10
	Sept. 14/70	.03	.37	.002	.02	.014	.002	trace
	Sept. 15/70	.03	.38	.003	.017	.025	.002	trace
	Sept. 16/70	.03	.35	.003	.017	.007	.002	trace
	Sept. 17/70	.03	.30	.002	.02	.009	.003	trace
	Sept. 18/70	.02	.39	.002	.03	.006	.002	0.05
	Sept. 19/70	.02	.28	.003	.017	.006	.002	trace
	Sept. 20/70	.02	.59	.003	.007	.007	.001	0.10
	Sept. 21/70	.01	.33	.004	.016	.009	.002	trace
44	Sept. 11 - 21/70							
	Minimum	.01	.28	.001	<.01	.006	.001	trace
	Maximum	.04	.59	.004	.03	.025	.003	0.10
	Median (11)	.03	.39	.002	.017	.009	.002	trace
40	Sept. 11/70	.03	.50	.002	<.01	.032	.002	0.10
	Sept. 12/70	.04	.41	.002	.02	.028	.005	0.10
	Sept. 13/70	.05	.53	.003	<.01	.025	.004	0.05
	Sept. 14/70	.04	.55	.002	<.01	.027	.002	0.05
	Sept. 15/70	.03	.46	.003	.007	.024	.003	0.05
	Sept. 16/70	.03	.45	.003	.007	.027	.003	0.05
	Sept. 17/70	.02	.47	.001	<.01	.019	.003	0.05
	Sept. 18/70	.01	.46	.002	<.01	.016	.003	trace
	Sept. 19/70	.01	.35	.003	.007	.015	.002	0.01
	Sept. 20/70	.01	.51	.003	.007	.016	.002	0.05
	Sept. 21/70	.01	.37	.003	.007	.016	.001	0.05

TABLE V (Cont'd)

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	NITROGEN AS N: FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P: TOTAL	SOLUBLE	IRON As Fe
40	Sept. 11 - 21/70							
	Minimum	.01	.35	.001	<.01	.015	.001	trace
	Maximum	.05	.55	.003	.02	.032	.005	.10
	Median (11)	.03	.46	.003	.007	.024	.003	.05
68	Sept. 11/70	.04	.39	.002	<.01	.020	.004	0.10
	Sept. 12/70	.02	.39	.001	<.01	.017	.002	0.05
	Sept. 13/70	.04	.47	.002	<.01	.022	.002	trace
	Sept. 14/70	.03	.49	.002	<.01	.022	.002	trace
	Sept. 15/70	.01	.43	.003	.007	.020	.003	0.15
	Sept. 16/70	.01	.43	.003	.007	.019	.002	0.05
	Sept. 17/70	.01	.43	.009	.01	.018	.002	0.05
	Sept. 18/70	.01	.60	.002	<.01	.016	.002	trace
	Sept. 19/70	.01	.46	.003	.007	.004	.002	trace
	Sept. 20/70	.01	.42	.003	.007	.017	.002	0.10
	Sept. 21/70	.01	.34	.003	.007	.020	.001	0.05
68	Sept. 11 - 21/70							
	Minimum	.01	.34	.001	<.01	.004	.001	trace
	Maximum	.04	.60	.009	.01	.022	.004	.15
	Median (11)	.01	.43	.003	.007	.019	.002	.05
15	Sept. 11/70	.03	.42	.001	<.01	.022	.003	0.10
	Sept. 12/70	.01	.43	.001	<.01	.023	.003	0.30
	Sept. 13/70	.05	.58	.002	<.01	.025	.003	0.05
	Sept. 14/70	.03	.49	.002	<.01	.028	.003	trace
	Sept. 15/70	.02	.48	.002	.008	.023	.003	trace
	Sept. 16/70	.06	.41	.003	.007	.018	.003	trace
	Sept. 17/70	.03	.51	.002	<.01	.026	.004	trace
	Sept. 18/70	.01	.52	.002	<.01	.016	.002	0.05
	Sept. 19/70	.01	0.55	.003	.007	.051	.002	0.05
	Sept. 21/70	.01	.41	.002	.008	.022	.001	0.05
15	Sept. 11 - 21/70							
	Minimum	.01	.41	.001	<.01	.016	.001	trace
	Maximum	.06	.58	.003	.008	.051	.004	.30
	Median (10)	.03	.49	.002	.01	.023	.003	.05

TABLE V (Cont'd)

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	NITROGEN AS N FREE AMMONIA	TOTAL KJELDAHL	NITRITE	NITRATE	PHOSPHORUS AS P TOTAL	SOLUBLE	IRON As Fe
33	Sept. 11/70	.03	.40	.001	<.01	.027	.002	0.20
	Sept. 12/70	.02	.44	.002	<.01	.034	.004	0.10
	Sept. 13/70	.03	.42	.002	<.01	.033	.003	0.05
	Sept. 14/70	.03	.47	.002	<.01	.040	.002	0.05
	Sept. 15/70	.03	.53	.002	.008	.027	.003	0.05
	Sept. 16/70	.03	.59	.003	.007	.026	.002	0.05
	Sept. 17/70	.01	.61	.001	<.01	.033	.003	0.05
	Sept. 18/70	.01	.54	.001	<.01	.026	.002	trace
	Sept. 19/70	.01	.50	.003	.007	.044	.003	trace
	Sept. 21/70	.01	.49	.003	.007	.030	.002	0.05
33	Sept. 11 - 21/70							
	Minimum	.01	.40	.001	<.01	.026	.002	trace
	Maximum	.03	.61	.003	.008	.044	.004	.20
	Median (10)	.02	.50	.002	<.01	.032	.003	.05

TABLE V

STONY, CLEAR & LOVESICK LAKES

CHEMICAL RESULTS

September 11 - 21, 1970

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3	pH
78	Sept. 11/70	10	88	75	30	3	5	8	188	-
	Sept. 12/70	10	90	75	30	4	5	6	187	-
	Sept. 13/70	10.5	88	78	31	2	6	6	195	8.0
	Sept. 14/70	7	88	77	31	2	5	6	192	8.1
	Sept. 15/70	10	94	77	32	3	4	4	191	7.9
	Sept. 16/70	8	92	76	32	3	4	4	191	8.0
	Sept. 17/70	10	88	75	31	2	4	6	187	8.0
	Sept. 18/70	9.5	--	75	32	3	5	4	188	-
	Sept. 19/70	8	88	78	31	2	6	3	193	-
	Sept. 20/70	8.5	90	78	32	2	5	3	191	-
	Sept. 21/70	10.5	90	77	32	2	5	4	193	-
78	Sept. 11- 21/70									
	Minimum	7.0	88	75	30	2	4	3	187	7.9
	Maximum	10.5	94	78	32	4	6	8	195	8.1
	Median (11)	10.0	89	77	31	2	5	4	191	8.0
2	Sept. 11/70	10	88	73	29	4	4	8	181	-
	Sept. 12/70	10.0	92	75	31	3	4	6	184	-
	Sept. 13/70	7	92	75	26	7	5	6	188	7.9
	Sept. 14/70	8	88	74	31	2	5	6	187	8.0
	Sept. 15/70	6	90	77	31	3	4	4	189	7.9
	Sept. 16/70	8.5	92	76	32	2	5	6	191	7.9
	Sept. 17/70	9.5	92	76	32	3	4	3	183	7.9
	Sept. 18/70	10	--	75	31	2	5	6	188	-
	Sept. 19/70	9.5	88	77	31	2	5	2	189	-
	Sept. 20/70	7.5	92	76	31	3	5	2	191	-
	Sept. 21/70	9.5	92	76	31	3	6	4	190	-

TABLE V (Cont'd)

STONY, CLEAR & LOVESICK LAKES - September 11 - 21, 1970

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3	pH
2	Sept. 11 - 21/70									
	Minimum	6.0	88	73	26	2	4	2	181	7.9
	Maximum	10.0	92	77	32	7	6	8	191	8.0
	Median (11)	9.5	92	76	31	3	5	6	188	8.0
60	Sept. 11/70	8.5	78	68	28	2	4	4	169	-
	Sept. 12/70	7.5	80	67	28	2	3	4	160	-
	Sept. 13/70	7.5	76	69	24	3	4	4	161	8.1
	Sept. 14/70	7.5	80	68	28	2	4	3	168	8.1
	Sept. 15/70	7.5	80	68	29	2	4	2	167	7.9
	Sept. 16/70	7.5	76	68	28	1	3	2	170	7.9
	Sept. 17/70	8	76	67	24	2	3	2	158	8.0
	Sept. 18/70	7	--	67	28	1	4	4	170	-
	Sept. 19/70	9.5	88	69	29	2	5	2	189	-
	Sept. 21/70	7.5	88	68	32	2	4	4	168	-
60	Sept. 11 - 21/70									
	Minimum	7.0	76	67	24	1	3	2	158	7.9
	Maximum	9.5	88	69	32	3	5	4	189	8.1
	Median (10)	7.5	80	68	28	2	4	3	168	8.0
44	Sept. 11/70	8	80	69	28	2	4	4	170	-
	Sept. 12/70	7.5	80	68	28	2	3	4	162	-
	Sept. 13/70	7	96	69	36	3	4	4	165	8.2
	Sept. 14/70	6.5	76	69	24	2	4	4	174	8.1
	Sept. 15/70	7	80	70	29	2	4	3	171	7.9
	Sept. 16/70	8	80	69	29	2	4	2	170	7.9
	Sept. 17/70	7.5	74	68	24	1	4	1.5	162	7.9
	Sept. 18/70	8	--	69	29	1	3	2	172	-
	Sept. 19/70	7.5	78	69	28	2	5	2	168	-
	Sept. 20/70	8.5	82	71	28	3	5	1	170	-
	Sept. 21/70	8.5	86	71	30	2	4	2	175	-

TABLE V (Cont'd)

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromohs per cm^3	pH
44	Sept. 11 - 21/70									
	Minimum	6.5	74	68	24	1	3	1	162	7.9
	Maximum	8.5	96	71	36	3	5	4	175	8.2
	Median (11)	7.5	80	69	28	2	4	2	170	7.9
40	Sept. 11/70	10	90	77	31	3	4	6	188	-
	Sept. 12/70	7.5	90	76	31	3	4	4	188	-
	Sept. 13/70	7	92	70	32	3	4	2	164	8.2
	Sept. 14/70	7	88	77	31	2	5	6	189	8.1
	Sept. 15/70	9	92	76	32	2	4	4	188	8.2
	Sept. 16/70	9.5	90	77	31	3	4	4	187	8.1
	Sept. 17/70	9.5	88	73	31	2	4	6	185	8.2
	Sept. 18/70	9	--	75	31	2	4	4	187	-
	Sept. 19/70	9.5	88	75	31	2	5	3	184	-
	Sept. 20/70	9	88	76	32	2	5	2	185	-
	Sept. 21/70	9.5	90	75	32	2	5	3	186	-
40	Sept. 11 - 21/70									
	Minimum	7	88	70	31	2	4	2	164	8.1
	Maximum	10	92	77	32	3	5	6	189	8.2
	Median (11)	9	90	76	31	2	4	4	187	8.2
68	Sept. 11/70	8	90	77	30	3	4	8	188	-
	Sept. 12/70	7.5	90	77	31	3	4	4	188	-
	Sept. 13/70	7.5	96	79	36	3	4	6	189	8.2
	Sept. 14/70	6	88	76	31	2	5	4	191	8.1
	Sept. 15/70	9.5	92	79	32	2	4	4	187	8.3
	Sept. 16/70	9.5	94	77	32	3	4	4	187	8.3
	Sept. 17/70	19	86	75	31	2	4	4	187	8.4
	Sept. 18/70	9.5	--	75	32	3	5	3	176	-
	Sept. 19/70	10	88	77	31	2	6	3	187	-
	Sept. 20/70	8	90	77	32	2	5	1.5	191	-
	Sept. 21/70	9.5	90	76	32	2	5	4	187	-

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3	pH
68	Sept. 11- 21/70									
	Minimum	6.0	86	75	30	2	4	1.5	176	8.1
	Maximum	19.0	96	79	36	3	6	8	191	8.4
	Median (11)	9.5	90	77	32	2	4	4	187	8.3
15	Sept. 11/70	10.5	88	76	31	2	4	6	185	-
	Sept. 12/70	8.0	88	76	31	2	4	4	184	-
	Sept. 13/70	7.5	88	75	31	2	5	6	187	8.1
	Sept. 14/70	8	88	74	31	2	4	4	191	8.1
	Sept. 15/70	8.5	88	76	30	2	4	4	188	8.1
	Sept. 16/70	7	88	77	30	2	4	3	189	8.1
	Sept. 17/70	9.5	88	73	31	2	4	6	182	8.2
	Sept. 18/70	9.5	--	75	30	4	4	4	186	-
	Sept. 19/70	10.5	88	77	31	1	6	1.5	185	-
	Sept. 21/70	9	90	79	32	2	5	4	190	-
33	Sept. 11/70	8.5	98	81	31	2	4	6	197	-
	Sept. 12/70	9.5	92	82	33	2	5	8	198	-
	Sept. 13/70	6	96	82	34	3	5	4	204	8.2
	Sept. 14/70	6	96	81	36	3	5	6	197	8.1
	Sept. 15/70	6	92	78	32	3	4	4	193	8.1
	Sept. 16/70	7.5	92	79	32	3	4	4	193	8.1
	Sept. 17/70	10	92	79	36	3	4	6	190	8.3
	Sept. 18/70	9	--	79	33	3	5	4	194	-
	Sept. 19/70	9	94	83	44	2	5	2	190	-
	Sept. 21/70	10.5	92	81	31	3	5	3	190	-

TABLE V (Cont'd)

STONY, CLEAR & LOVESICK LAKES - September 11 - 21/70

SAMPLING POINT	DATE	ORGANIC CARBON	HARDNESS as $CaCO_3$	ALKALINITY as $CaCO_3$	CALCIUM as Ca	MAGNESIUM as Mg	CHLORIDE as Cl	TURBIDITY in Units	CONDUCTIVITY in Micromhos per cm^3	pH
15	Sept. 11 - 21/70									
	Minimum	7	88	73	30	1	4	1.5	182	8.1
	Maximum	10.5	90	79	32	4	6	6	190	8.2
	Median (10)	9	88	76	31	2	4	4	187	8.1
33	Sept. 11 - 21/70									
	Minimum	6	92	78	31	2	4	2	190	8.1
	Maximum	10.5	98	83	44	3	5	8	204	8.3
	Median (10)	9	92	81	33	3	5	4	194	8.1

APPENDIX A

SIGNIFICANCE OF ANALYSES

BACTERIOLOGICAL INDICATOR ORGANISMS

The TOTAL COLIFORM group is defined, according to Standard Methods (A.P.H.A., 1965), as "all of the aerobic and facultative anaerobic, gram-negative, non-sporeforming rod-shaped bacteria which ferment lactose with gas formation within 48 hr. at 35°C." This definition includes, in addition to the intestinal forms of the Escherichia coli group, closely related bacteria of the genera Citrobacter and Enterobacter. The Enterobacter-Citrobacter groups are common in soil, but are also recovered in feces in small numbers. Their presence in water may indicate soil run-off or, more important, less recent fecal pollution since organisms of the Enterobacter-Citrobacter groups tend to survive longer in water than do members of the Escherichia group, and even to multiply when suitable environmental conditions exist (Geldreich, 1966).

The FECAL COLIFORM test is an attempt to devise a more specific test for coliforms of intestinal origin. Here, incubation of the organisms is at 44.5°C. Though by no means 100% exclusive for Escherichia coli, this parameter has proved useful as an indicator of recent fecal pollution.

FECAL STREPTOCOCCI (or enterococci) are also valuable indicators of recent fecal pollution. These organisms are large, ovoid, grampositive bacteria, occurring in chains. They are normal inhabitants of the large intestine of man and animals, and they generally do not multiply outside the animal body. In waters polluted with fecal material, fecal streptococci are usually found along with coliform bacteria, but in smaller numbers. In some waters they may be found alone (Geldreich, 1966). Their presence, along with coliforms, indicates that at least a portion of the coliforms in the sample are of fecal origin.

The OWRC Guidelines and Criteria for Water Quality Management in Ontario (1970) state that water used for body contact recreational activities can be considered impaired when the coliform, fecal coliform, and/or enterococcus geometric mean density exceeds, 1000,100 and/or 20 per 100 ml respectively, in a series of at least

ten samples per month, including samples collected during weekend periods.

The results of the examinations are reported as organisms per 100 ml of sample.

References: Geldreich, E.C., 1966 - Sanitary Significance of Fecal Coliforms in the Environment. Water Pollution Control Research Series, U.S. Department of Interior Federal Water Pollution Control Administration Publication WP-20-3.

Bennett, E.A., 1969 - Bacteriology of the Great Lakes in "The Great Lakes as an Environment" Edited by D.V. Anderson, Great Lakes Institute Report PR 39, University of Toronto

ALKALINITY

The alkalinity is a measure of the power of a solution to neutralize hydrogen ions (acids) and is expressed in terms of an equivalent amount of calcium carbonate. The alkalinity of natural waters is caused by the following three major materials:

Carbonates
Bicarbonates and other salts of week acids
Hydroxides (rately present in Ontario).

The alkalinity of water has little sanitary significance but is of importance in water, sewage and industrial waste treatment practices.

CALCIUM AND MAGNESIUM

Elemental calcium and magnesium do not occur in nature. However, their salts and ions are among the most commonly encountered substances in water. They may result from the leaching of soil and other natural sources or they may be contained in sewage and many types of industrial wastes. The effects of calcium and magnesium are mainly associated with hardness.

CHLORIDES

Chlorides are universally present in domestic and many industrial wastes and naturally in most waters. The OWRC Guidelines and Criteria (1970) state the permissible level for chloride is 250 ppm in water intended for use in public water works. At concentrations above 250 ppm, water begins to taste salty.

COLOUR

Colour is determined by visual comparison of the sample with known concentrations. The intensity is reported in Hazen Colour Units.

The colouration of natural waters may result from organic matter or other chemical substances, which occur naturally or are introduced into the water through waste water discharges.

CONDUCTIVITY

The conductivity of a solution is a measure of its ability to carry an electrical current, and varies with the number and type of ions the solution contains. The presence of dissolved irons such as calcium, chloride, etc., renders water conductive. However, unionized weak acids or bases and uncharged soluble organic materials do not carry a current. In many waters there is a direct linear relationship between dissolved solids concentrations and conductivity. Conductivity serves as a control parameter and is an excellent indicator of water quality changes since it is relatively sensitive to variations in dissolved solids concentrations. Since they are more precise, particularly at low concentrations, conductivity measurements have largely replaced the total dissolved solids test. Conductance is the reciprocal of resistance and is recorded in the unit mho. Natural waters have specific conductance values which are less than one mho and, in order to avoid inconvenient decimals, data are reported in micromhos per centimeter cube.

DISSOLVED OXYGEN

Dissolved oxygen in water is derived from the air directly or through the photosynthetic process of aquatic plants. Ample dissolved oxygen is vital to maintain satisfactory fish and other biological life in water. As a result, a minimum criterion of 5 ppm is recommended. Organic wastes and in some cases inorganic materials exert, upon decomposition, an oxygen demand which may deplete the dissolved oxygen below levels required by aquatic life.

The content of dissolved oxygen in water at equilibrium with a normal atmosphere is a function of the temperature and salinity of the water, the ability of water to hold oxygen decreasing with increases in temperature or dissolved solids. Natural waters are seldom at equilibrium and seldom exactly saturated with dissolved oxygen, for temperatures are changing and physical chemical, bio-chemical, or biological activities are utilizing or liberating oxygen.

HARDNESS

This term is applied to the soap-neutralizing power of water. Hardness is attributable principally to calcium and magnesium cations and is independent of the

anions in solution. The hardness generally reflects the nature of the geological formations with which it has been in contact; however, some industrial wastes and return flow from irrigation drainage will affect hardness.

No specific limit is placed on hardness although it is usually recommended that water for domestic uses should contain less than 250 ppm hardness as $CaCO_3$. This objective has been used to avoid excessive soap consumption.

IRON

Iron appears in water as metallic ions, in organic compounds, and as a colloid.

The metallic ion form is due to corrosion of metallic iron and its alloys, the discharge of iron-bearing industrial wastes, and the leaching of soluble iron salts from soil and rocks. As an ion, it may be present in the ferrous or bi-valent form such as ferrous bicarbonate which can only exist in the absence of oxygen, or the ferric or tri-valent form such as ferric hydroxide (a precipitate) which is almost completely insoluble. Water can dissolve greater amounts of iron as ferrous bicarbonate when it is nearly free of dissolved oxygen, contains adequate amounts of carbon dioxide, does not have a pH above 7.5, and organic substances arising from decomposition are present which can reduce ferric hydroxide.

Also, humic acids present in so-called brown waters, form colloidally dissolved humates with iron. These organic-iron sols are much more stable than inorganic bicarbonate solutions and for this reason, humus waters usually contain considerable amounts of iron even in the presence of dissolved oxygen.

Therefore, the conditions in most surface waters (eg. high oxygen content) are opposite to those that favour the solution of iron. However, in an eutrophic lake where the oxygen content on the bottom water sinks to nearly zero, then all the conditions for the reduction of ferric hydroxide and the solution of ferrous bicarbonate are realized, since decomposing organic substances and aggressive carbon dioxide are present. Iron is reduced in the mineral fraction of suspended particles and in the bottom sediments, and dissolved as ferrous bicarbonate. Throughout the stagnation, the iron content of the bottom

waters constantly increases. Upon recirculation and the introduction of oxygen into the oxygen-deficient waters, the iron re-precipitates and settles on the bottom, thereby being trapped in the bottom waters. As a result, there is a progressive iron enrichment in the sediment of eutrophic lakes.

The permissible criterion for iron in water supplies is 0.3 ppm.

NITROGEN

Free ammonia nitrogen is the soluble product in the decomposition of nitrogenous organic matter. It is also formed when nitrites and nitrates are reduced to ammonia either biologically or chemically. Small amounts of ammonia, too, may be taken out of the atmosphere by rain water. The following values may be of general significance in appraising free ammonia content: Low: 0.015 - 0.03 ppm, Moderate: 0.03 - 0.10 ppm, High: 0.10 ppm or greater.

Total kjeldahl is a measure of the total nitrogenous matter present except that measured as nitrite and nitrate. The total kjeldahl less the ammonia nitrogen gives a measure of the organic nitrogen present. Ammonia and organic nitrogen determinations are important in assessing the availability of nitrogen for biochemical utilization. The normal range for total kjeldahl is 0.1 - 0.5 ppm.

Nitrite nitrogen is usually an intermediate oxidation product of ammonia. The significance of nitrites, therefore, varies with their amount, source and relation to other constituents of the samples, notably the relative magnitude of ammonia and nitrate present. Since nitrite is rapidly and easily converted to nitrate, its presence in concentrations greater than a few thousandths of a part per million is generally indicative of active biological processes in the water.

Nitrate nitrogen is the end product of aerobic decomposition of nitrogenous matter, and its presence carries this significance. Nitrate concentration is of particular interest in relation to the other forms of nitrogen that may be present in the sample. Nitrates occur in the crust of the earth and are a source of its fertility. The following ranges in concentration may be

used as a guide: Low - less than 0.1 ppm; Moderate - 0.1 - 1.0 ppm: High - greater than 1.0 ppm.

pH

The symbol pH is used to designate the logarithm (base 10) of the reciprocal of the free hydrogen-ion concentration. It is used to express the intensity of the acid or alkaline condition of a solution. The practical pH extends from 0, very acid, to 14, very alkaline, with the middle value of pH 7 corresponding to exact neutrality (at 25°C).

pH does not measure the total amount of acidity (or alkalinity) in the water, since some may be in a combined form and therefore will not be included in the pH measurement of free hydrogen ions. The combined forms can still be released to react with bases. The commonest example in water is the bicarbonate ion, which can react with acids to form carbonic acid, or with bases to form carbonates and water.

The OWRC permissible criterion for pH in public surface water supplies is a range from 6.0 to 8.5.

PHOSPHORUS

Phosphorus is an essential plant nutrient and is believed to play an important role in the deterioration of the quality of natural waterways by promoting an over-abundance of plants. It occurs in natural and waste waters in several different chemical combinations, such as orthophosphate (PO_4), organic phosphates and polyphosphates. Since most or all of these forms can eventually be used by plants and animals, determination of the TOTAL PHOSPHORUS concentration is more relevant than measurement of individual phosphorus compounds.

The SOLUBLE PHOSPHORUS content of a sample is that fraction which will pass through a filter and will react chemically with the reagents used to determine the concentration of orthophosphate yielding a positive test response. It is generally accepted that some organic and even particulate forms can react similarly to orthophosphate and, for this reason, the results are often referred to as "soluble reactive phosphorus", which removes the implication that the test measures only orthophosphate.

TURBIDITY

Turbidity is due to the material in suspension which may not be of sufficient size to be seen as individual particles by the naked eye, but which reduces the passage of light through the liquid. High turbidity is undesirable in natural waters, particularly those which are used for recreational purposes. It is an expression of the optical property of a sample and results are reported in Turbidity Units.

Reference: Outlines of Analytical Methods compiled by Dr. T.G. Brydges, Chemistry Branch, Division of Laboratories, OWRC.